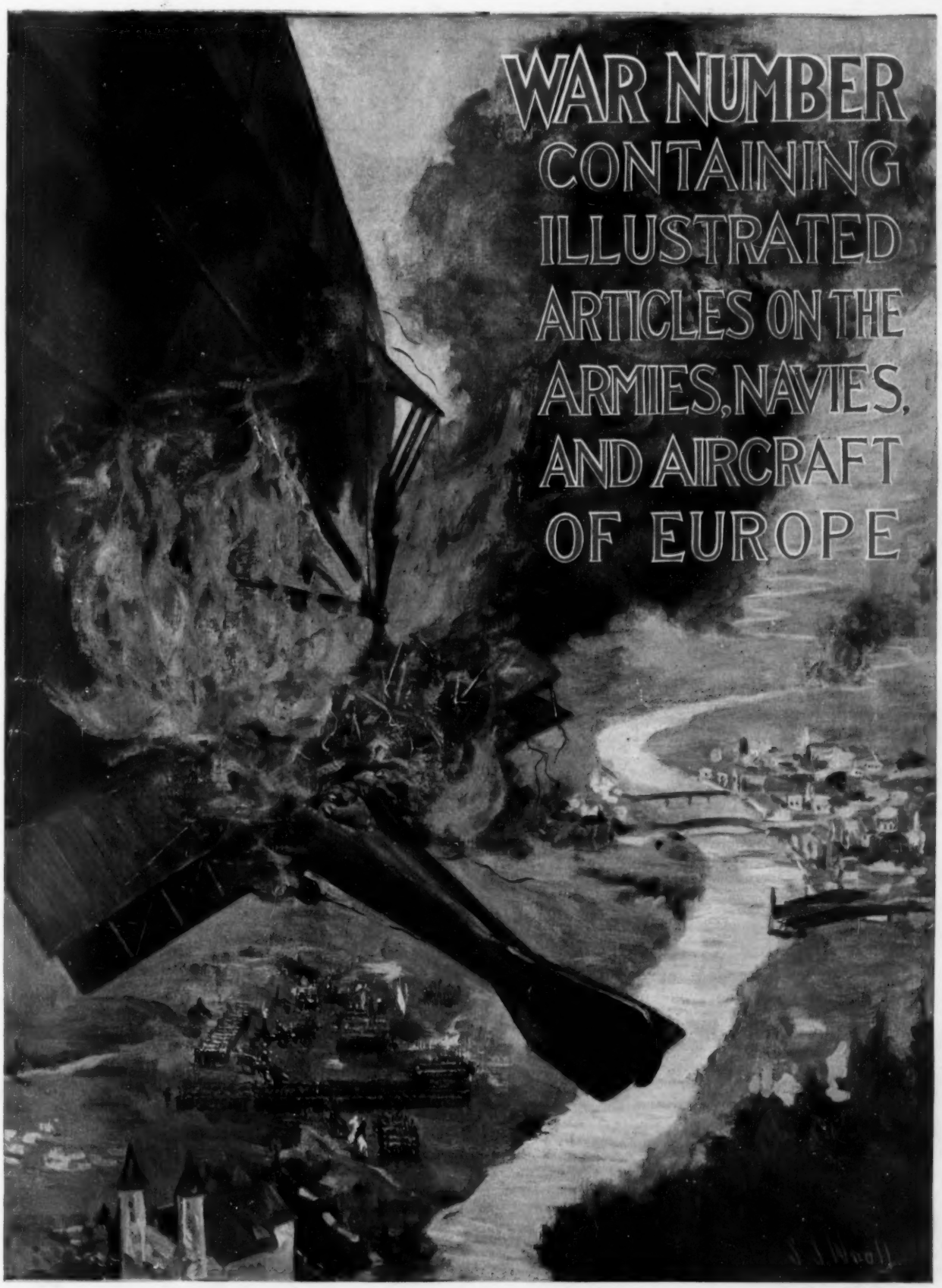
WITH COLORED WAR MAP

SCIENTIFIC AMERICAN



Vol. CXI. No. 10
September 5, 1914

Munn & Co., Inc., Publishers
New York, N. Y.

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THE NEW PACKARD "3-38"

This latest Packard Six invites your patronage. The sum of these distinctive features can be found in no other car.

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Packard Centralized Control Board

Packard-Bijur Electric Starter

Packard-Bijur Electric Lights

Separate Magneto Ignition

Packard Unit Power Plant

Mud-Tight Motor

Concealed Force Feed Oiling to Thirty-five Points

Packard Hydraulic Governor

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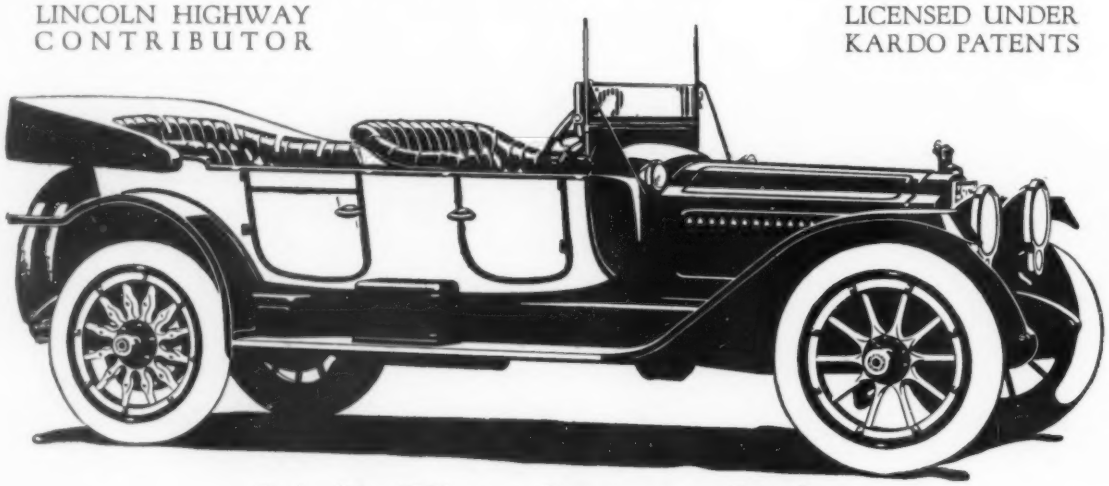

Packard "3-38" Phaeton. Five passengers. Price $3750

WHITE MOTOR TRUCKS Are the Nation's Choice

BOTH IN THE QUANTITY OF TRUCKS SOLD AND IN THE VALUE OF TRUCK SALES, WE ARE THE LARGEST MANUFACTURERS OF COMMERCIAL MOTOR VEHICLES IN AMERICA

Official Records of the Motor Truck Industry Verify This Statement

This Leadership of the Truck Industry is of the utmost importance, both to the many who already own White Trucks, and to the many others who will eventually purchase White Trucks.

TO THE OWNERS OF WHITE TRUCKS

THIS LEADERSHIP proves the correctness of your judgment in selecting your motor truck equipment.

It shows that you have chosen the same motor truck that the majority of truck users in America have selected.

In practically every case, this selection has been the result of a process of rigid experimentation and elimination, in which White Trucks have proved their superiority over all others.

This preference for White Trucks by the largest users of motor trucks as well as by the majority of motor truck users guarantees that your investment is protected by a successful, well established manufacturer, having a superior organization for rendering permanent and efficient service during the life-time of the trucks.

TO FUTURE OWNERS OF WHITE TRUCKS

THIS LEADERSHIP is conclusive proof that White Trucks must be superior to all others, because White Supremacy is not measured in numbers alone, but in value as well.

With so many makes of motor trucks on the market, all clamoring for recognition, indisputable supremacy can be gained only by superior merit.

Untruthful advertising, bargain prices, exaggerated claims and guarantees that cannot be fulfilled may make the first sale, but only superior merit can create the confidence which brings continuous repeat orders.

The record of continuous repeat orders whereby the foremost firms in America have acquired huge fleets of White Trucks, after experimenting with other makes, is a convincing reason why you should use White Trucks.

WHITE TRUCKS ARE MOST ECONOMICAL TO OWN

That White Trucks are slightly higher in price, makes White leadership in the truck industry even more complete. It is plain evidence that White construction is so superior that the higher first cost of a White Truck is economy in the long run—proof that White Trucks last longer and cost less to operate and maintain, making them the most economical trucks to own.

White Trucks are built in capacities of ¾, 1½, 3 and 5 tons

A SUITABLE SIZE FOR EVERY VARIETY OF SERVICE

THE WHITE COMPANY

CLEVELAND

MANUFACTURERS OF GASOLINE MOTOR CARS, MOTOR TRUCKS AND TAXICABS

For War or Peace
The Jeffery Quad

49% GRADE

A 49 per cent grade is easily surmounted by a Jeffery Quad under load. Where an ordinary truck merely pushes its load by its rear wheels, the Jeffery Quad pushes and pulls with all four wheels. It literally *clambers* up. Notice how the brakes hold. They operate on all four wheels and on the transmission shaft.

LUMBER PILE

The Parsons Lumber Co. find the Jeffery Quad invaluable for carrying lumber to any point, such as off the road beside a new building, where it may be needed. The Quad frequently saves one handling of the lumber.

DITCH

Even if one set of wheels on the Jeffery Quad are deep in a ditch the other pair will pull it out. The Quad will carry its load across the roughest country.

WHEN the French army went to the front the other day to fight Germany, they carried their provisions in a four wheel drive truck.

When the Parsons Lumber Company, of Rockford, Illinois, found itself face to face with the problem of delivering lumber outside the city limits, where the roads were extremely bad, they sent for a Jeffery Quad.

The Jeffery Quad has been built to specifications furnished by the United States government. It is designed to go anywhere that a four mule team can go. Since its adoption by the government in the operations on the Mexican border a year ago, it has demonstrated its capacity for this service.

At the same time engineers have concluded that this type of truck alone is adapted to certain kinds of service which the two wheel drive truck cannot satisfactorily perform.

Walter Wardrop, editor of Power Wagon, when he saw this truck perform at the Jeffery factory the other day, said, "That is the greatest traction demonstration I have ever witnessed."

Mining engineers, representatives of contractors, brick makers and experts in all lines of trades are coming to the Jeffery plant at Kenosha, Wisconsin, to witness these demonstrations. So startling are they in their character, so spectacular, that they have been portrayed in moving pictures in connection with United States army tests.

The photographs here merely suggest a few uses to which this most remarkable truck can be put. Here are a few of the things that it does:

It drives, brakes and steers on all four wheels.

It will turn in a forty-one foot circle, because the wheels track absolutely.

It will climb loaded a 49% grade as shown in the illustration.

It will drop head first into a three foot ditch and climb out again.

It will carry a load of two tons besides hauling trailers loaded with from eight to twelve tons on a hard level road. It is the only truck that will pull itself out of an excavation. It is the only truck of its kind in the United States built by a concern with sufficient finances and stability to make its production a success.

It is the same type of truck which has been adopted exclusively by the French army.

It is the truck which is now in the service of the United States government.

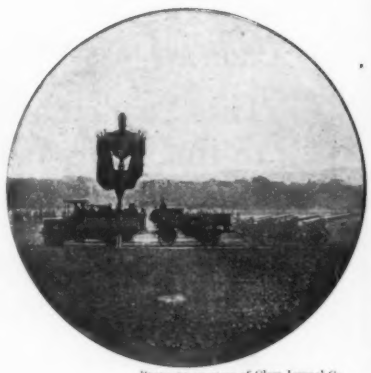

Photo. by courtesy of Class Journal Co.

FRENCH ARMY TRUCK

French army supplies are taken to the front in four wheel drive trucks, similar to the Jeffery Quad.

TRAILERS

The Jeffery Quad will carry its own rated load, and in addition a trailer load of from 8 to 12 tons on a hard level road.

UNITED STATES QUARTERMASTER

United States Army tests are extremely severe. The Jeffery Quad successfully met the army demand for a truck capable of taking its load "wherever four army mules can go."

Jeffery Trucks: Jeffery Quad—Jeffery 1½ ton—Jeffery ¾ ton

The Thomas B. Jeffery Company

Main Office and Works, Kenosha, Wisconsin

SEVENTIETH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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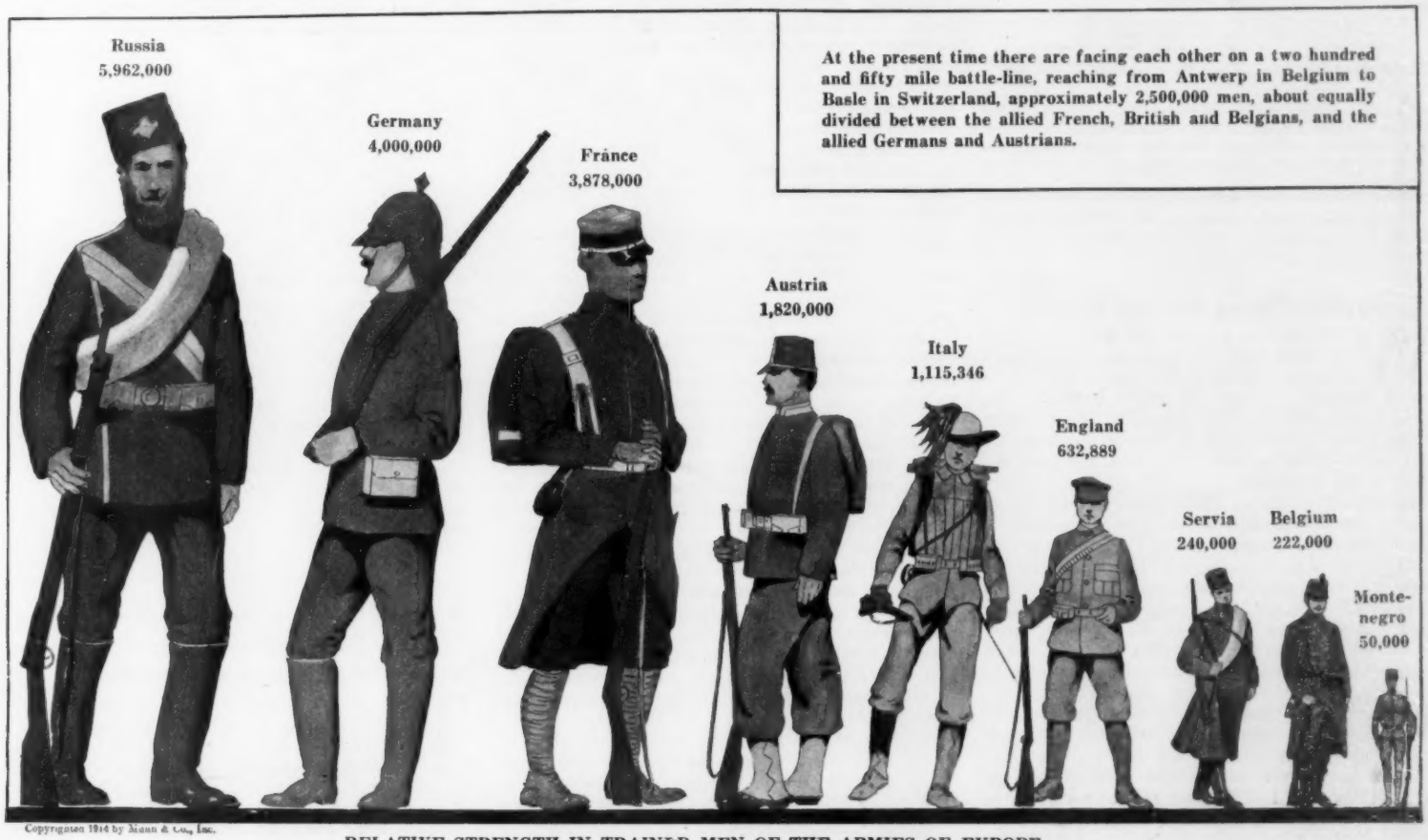

At the present time there are facing each other on a two hundred and fifty mile battle-line, reaching from Antwerp in Belgium to Basle in Switzerland, approximately 2,500,000 men, about equally divided between the allied French, British and Belgians, and the allied Germans and Austrians.

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RELATIVE STRENGTH IN TRAINED MEN OF THE ARMIES OF EUROPE

Sixteen Million Men Under Arms

Military Strength of the Triple Entente and the Dual Alliance

TO appreciate the stupendous character of the War of the Nations which is now in full swing on the continent of Europe, we must bear in mind two facts: first, that it is a war to the death; second, that in the full realization of the absolute finality of the result, every one of the contending nations has already called out or has stated that it will do so, the whole of its trained reserves, thus putting some sixteen millions of men under arms.

In the interests of humanity it is better that the nations which go down in absolute defeat should realize that the verdict is one against which there is no appeal. If the only possible cure for this monstrous cancer of militarism is the knife, it is better to cut so deeply as to let out all the rottenness, and so thoroughly remove the very seeds of disease as to ensure the wholesome, unhindered growth of the splendid civilization of this twentieth century.

The one mournful consolation to be drawn from this unspeakable calamity is to be found in the belief that the loss of life, the destruction of property, the paralysis of trade and industry, and the total setback of civilization, will be so stupendous as to bring the nations of the earth together, when the war is over, in the endeavor to substitute for the present brutal armaments, an International Tribunal backed by an International Military Police.

In point of magnitude the present conflict is absolutely without a parallel. Never, in all the history of the world, have there been marshaled on the field of battle armies that even approached in numbers the hosts which are drawn up upon the frontiers of Germany and Austria. Not in the campaigns of Napoleon, nor the great Franco-German struggle of 1870-71, nor yet the seven-day battle of Mukden between Russia and Japan, was there seen such a gathering of warring hosts. As for the historic conflicts of ancient days, when the hordes of the East poured in a human flood over Europe, later historical criticism has thrown doubt upon the reputed numbers engaged.

DUAL ALLIANCE.

Nation.	Population.	Standing Army.	Trained Reserves.	Untrained Reserves.
Austria	48,000,000	472,716	1,347,284	2,700,000
Germany	64,925,993	800,000	3,200,000	3,000,000
Totals	**112,925,993**	**1,272,716**	**4,547,284**	**5,700,000**
TRIPLE ENTENTE.				
England	45,370,000	156,000	476,889	3,500,000*
France	39,600,500	727,000	3,151,000	1,622,000
Russia	125,000,000	1,284,000	4,678,000	5,500,000
Totals	**209,970,500**	**2,167,000**	**8,305,889**	**10,622,000**

Total number of trained soldiers { **Dual Alliance** 5,820,000 / **Triple Entente** 10,472,889

* Probable number of men available for voluntary service, including 316,307 Territorial forces (similar to U. S. National Guard).

At the present writing it is not unlikely that there are facing each other on a two hundred and fifty-mile battle line, reaching from Antwerp, Belgium, to Basle, Switzerland, approximately 2,500,000 men, about equally divided between the allied French, British, and Belgians, and the allied Germans and Austrians. These represent the standing armies, the flower of the national troops engaged.

To the east, along the borders of Germany and Austria, Germany has massed by this time some 600,000 of her second line of reserves, and Austria is moving to her own northern frontiers, and to the assistance of Germany in Alsace and Lorraine another 400,000 men. Russia has announced that her mobilization is complete, which means that she is moving down upon the German and Austrian frontiers her standing army of over 1,250,000 men.

And the while these 5,000,000 troops are on the fighting line, there are being gradually assembled at the various camps and equipped for the field as they may be needed, the 10,000,000 trained reserves—everyone having spent two or three years with the colors.

In all the countries engaged in this war, except England, military service is compulsory. In England service is voluntary, the men enlisting for seven years, at the close of which they enter the reserve. The war strength of the English army is 156,000 men, and of these, three army corps, or 120,000, have been landed on the continent and form part of the allied army. The whole of the reserves, 476,000 strong, have been called to the colors, and will be sent to strengthen the allies.

Compulsory service, or conscription, as practised in the German army, where it was first fully developed, is broadly representative in its operation of the practice in all European armies.

Actual service in the German army begins at the age of 20. The young man joins the colors, and remains with them three years. He then passes to the reserve for four years, during which he is called out for training with his corps twice for a period of about six weeks. He is then drafted into the "first ban" of the Landwehr for five years, in which he is given two trainings lasting from eight to fourteen days. At 32, he passes into the "second ban," where he remains till he is thirty-nine. He now passes into the first ban of the Landsturm, where he remains until his 45th year. The second ban of the Landsturm consists of men who have had no military training.

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Munn & Co., Inc., 361 Broadway, New York

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Germany's Strong Strategic Position

WITH the war a month old, Austria is yet to be heard from, except in the rôle of the defeated; and already it begins to look as though Germany will have to depend upon her own strong arm to overthrow the mighty fleets and armies of the Allies. Judged in point of mere numbers, the odds are two to one against her on land, and three and a half to one on the sea.

But the history of war, whether ancient, medieval, or modern, teaches us that superiority in numbers is merely one among many important factors that win battles and make it ultimately possible to dictate terms to a thoroughly beaten enemy. Proof of this is to be found in that brilliant page of German history covered by the Seven Years' War, when Prussia, under her marvelous soldier king, Frederick the Great, waged a successful war against a combination of enemies, as strong, relatively, if not stronger, that that which confronts the German people in the present crisis.

The seemingly overwhelming numbers of the Triple Entente are greatly offset by the fact that Germany holds an unusually strong strategic position, both on sea and land, and that whereas her armies are of a common race, speaking a common language, the enemy is composed of three races, speaking no language in common, and differing widely in tastes, temperament, and traditions.

Of enormous advantage to Germany is the fact that the geography of the naval and military situation is such that she is planted squarely between her major enemies, France and Russia; and so long as she is supreme in the Baltic, it is impossible for those countries to effect a joint concentration of their troops in overwhelming numbers upon either frontier.

And Germany, be it remembered, has all the advantage of fighting on interior lines. Because of her admirable system of military railroads, many of them built with a view to just such a crisis as that which now confronts her, she can move her reserves quickly to either frontier and mass them at any point for attack or defense. Furthermore, if, as she hopes and firmly believes, she can succeed in crushing the French armies in a succession of conclusive engagements, her possession of the interior lines would enable her to move a portion of the flower of her army, which is now confronting France, to the eastern frontier for the repulse of the Russian invasion.

In the event of German reverses and a failure of her invasion of France, she would fall back upon her line of frontier fortifications, take up a strong defensive position, and hurl the bulk of her armies against the on-rolling tide of Russian invasion, which, at the present writing, appears to have gained a victory of imposing proportions. If this should be the course of events, the Germans would settle down to a war of defense, which might last for two or three years, and end in the contestants fighting each other to the point of utter exhaustion. There is no reason to believe that the German of the twentieth century has lost any of the powers of recuperation and dogged resistance which carried him through the seven years of war under the great Frederick.

No less upon the sea than upon the land is Germany favored by geographical conditions. To be convinced of this, it is sufficient to glance at the war map which forms the supplement to the present issue of the SCIENTIFIC AMERICAN. The allied fleets of England and France have a superiority, based on total tonnage, of over three to one over that of Germany and Austria, and a superiority in the first fighting line of dreadnoughts, of two to one. If to France is delegated the task of destroying the Austrian fleet in the Adriatic, the English fleet in the North Sea has twice as many dreadnoughts as that of Germany, or 31 to 16; of destroyers she has 167 to 130; and of submarines, 76 to 21. Under these conditions it would be hopeless for Germany to accept battle in the open. Ship for ship, the English dreadnoughts are more powerfully armed, and in seamanship and gunnery they are at least the equals of their opponents.

Hence, the Germans have either retired behind the heavy coast fortifications of their North Sea ports and harbors, or, as is more likely, they have taken shelter in the Baltic. The British admiral has orders to seek and destroy the German fleet. But how shall this be done? Wilhelmshaven and the mouth of the Elbe are thoroughly protected by coast fortifications and mines. These consist of heavy, long-range guns, and mortars whose shells would fall with great accuracy over the course which would have to be covered by a fleet that steamed in to a range at which its fire would be effective. The Japanese attack on the inferior Port Arthur defenses proved the futility of a naval attack upon such fortifications as those at Wilhelmshaven, Heligoland, and Cuxhaven.

Equally disastrous would it be for the English fleet to venture through the narrow straits which must be passed in entering the Baltic. These would be heavily mined, and in their confined waters the fleet would lose heavily also from destroyer and submarine attack.

Another and most important strategical advantage in the German situation is the Kaiser Wilhelm Canal, which affords quick passage for the largest battleships from the Baltic to the North Sea. This canal practically cuts the British fighting line in half. It was built for this very purpose.

For if the British should force their way into the Baltic, the German fleet could pass to the North Sea through the canal and the Elbe, steam to the English Channel, sink the vast fleet of transports that are carrying men and supplies to the English army in Belgium, and harry the whole English and French coasts.

Hence, in seeking to bring the German fleet to action, it would be necessary for England to leave half her fleet at the mouth of the Elbe and send the other half around Denmark into the Baltic. This would mean that, so far as her dreadnought strength is concerned, Germany could elect to fight either fleet under equal conditions.

The only other way to get at the Germans would be to reduce the coast fortifications with an expeditionary army. But the German coast on the North Sea is so shoal, that the landing of such a force from transports is out of the question. There remains only one way in which it could be attempted.

If England followed Germany's example by violating the neutrality of Holland, or should Holland enter the Triple Alliance, Amsterdam would form an excellent base for an expedition for the reduction of the Wilhelmshaven and Cuxhaven fortifications. This would open the way for the seizure of the North Sea end of the Kiel Canal. Should Russia continue her successful invasion of Prussia, she might in time, though at an enormous sacrifice, capture Dantzig, Stettin, and, with the aid of the English, even Kiel itself. That would seal the doom of the German fleet.

Can it be done? The factors of time and cost are against it.

Eight Cylinders v. Six Cylinders

NOW that the six-cylinder automobile engine has attained to such universal popularity, thanks to the unremitting efforts of designers and builders, it does not seem altogether logical that it may soon be supplanted. But that it may be superseded at least in part, in the not far-distant future is a contingency with which the automobile world must concern itself. Already the eight-cylinder motor looms large on the horizon; for one of the largest of American makers has let it be known that henceforth a good part of his output will be driven by eight cylinders.

In thus taking one step in advance of his brother makers, for there is no other American eight-cylinder motor car, and only one foreign maker produces them, this American pioneer has given every thinking person abundant food for thought.

In the early days, when the single- and twin-cylinder motor held sway, motors with four cylinders were looked at askance as being just short of mechanical monstrosities; and no one had even thought of a six-cylinder car. And now comes the eight-cylinder motor, and it comes with a whole lot of sound common sense behind it and a number of reasons why it should make a bid for popular esteem.

It is true that the eight-cylinder motor has more parts than has the six; but if this multiplying of parts is examined carefully we find that the proposition is not as disturbing as might appear at first blush.

Power for power, the eight-cylinder motor need not necessarily be any larger or very much heavier than the six-cylinder motor. In fact, it may easily be the more compact of the two; for it presents the possibility of casting the cylinders V-fashion. In this way, the eight cylinders take up little if any more space longitudinally than the four—certainly less than the six—and little more transversely. The very compactness of such a design is an appealing feature.

As far as mechanical construction is concerned, the eight-cylinder motor has a number of advantageous features. In the first place, the crankshaft is considerably shorter than is the case with a six; and this feature tends to obviate even such slight chance of whipping in this member as may exist in longer crankshafts. Also, the crankshaft for an eight is simpler to make and requires less machining than that for a six; and this should reduce manufacturing cost.

Where the eight-cylinder motor has its cylinders cast in the shape of inverted L's with the valves all inside, valve operation is exceptionally simple; for a single camshaft centrally placed directly above the crankshaft serves to operate all sixteen of them. Again, problems of carburetion will be simplified by the possibility of locating the carbureter centrally with extremely short induction pipes.

When the question of eight cylinders versus six cylinders is first propounded, the addition of two cylinders, four valves, two pistons and connecting rods, two spark plugs, and perhaps other parts not now embodied in the six, appears a big step, and time only can tell how it will be received. The argument which centers about the addition of what appear to be unnecessary parts will not now be advanced against the eight-cylinder motor, for the simple reason that the simplicity and reliability of the four and the six have impressed themselves upon the mind of the motoring public. Nor is it likely that the question of fuel economy will enter largely; for already the records of foreign eight-cylinder motors, rating between 20 and 25 horse-power, show that one gallon of fuel generally will propel the car from 20 to 22 miles in an hour.

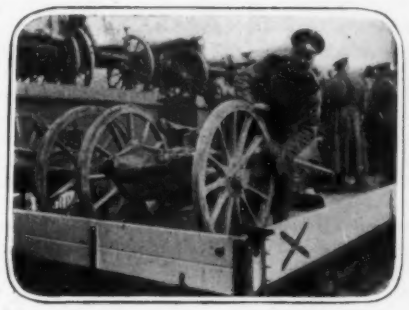
It is not likely that the eight-cylinder motor will come suddenly—as the six-cylinder motor did, for instance—but it surely appears likely that within a few years, say three or four, we may find ourselves viewing a very appreciable wave of eight-cylinder popularity.

The Composition of a European Army

THE numerical strength of the various units which compose a European army in the field differs so widely from that of our own army, that it is difficult for the average American to understand, in reading the European war dispatches, what number of troops is represented by the terms brigade, division, regiment, army corps, etc. The following statement is applicable, broadly, to all of the continental armies engaged in the present conflict.

The European regiment in full war strength numbers about 3,300 men, under the command of a colonel. Three regiments form a brigade of 10,000 men, commanded by a major-general. Two brigades form a division of 20,000 men, under the command of a lieutenant-general. Two divisions constitute an army corps of 40,000 men, commanded by a general, and three army corps form an independent field army (fully equipped with cavalry, artillery, commissary, engineers, and medical department) of a total strength of 120,000 men. There are variations from these totals as given, but they are not great, and the above estimate of the strength of the various units if applied to the number of divisions, brigades, army corps, etc., mentioned in the dispatches will give a closely accurate estimate of the number of troops engaged.

Edible Flowers.—A consular report from Calcutta describes the uses made in India of the mahua tree (otherwise known as the mahwa, malwa, mowha, mowa, mowra, or illupei tree), which grows wild in the greater part of that country and is also cultivated to some extent. The cream-colored flowers appear from February to April, and arrive at maturity about the end of March. Each morning about sunrise the succulent corolla-tubes fall in great showers to the ground, which has been cleared to receive them. The fall from a single tree continues for from seven to ten days. The flowers are spread out in the sun to dry, their color changing to a reddish brown, and their peculiar sweet odor becoming more apparent. Though eaten fresh to a considerable extent, the majority of the crop is dried and cooked with rice or other grains. Mahua is extremely sweet, and not easily digested by persons unaccustomed to eating it. Sugar and molasses are made from it. The consul states that in the central provinces alone about 1,400,000 people use mahua regularly as an article of food. The flowers are also distilled and produce a strong liquor, not unlike a good Irish whiskey in flavor. The seeds of the same tree are used for the manufacture of mahua butter, which is used for food, as a lubricant, and as an illuminant.



Transporting Russian artillery on flat cars.

The Armament of the Warring Nations

Victory May Rest With the Superior Rifles, Field and Machine Guns

Russian horse artillery on the march.

THE three most important branches of an Army are: the Cavalry, the Artillery, and the Infantry. In addition to these there are the Coast Artillery, which among European nations is generally not very far developed, and the various general service branches, engineers, quartermasters, and commissaries. All of the latter are, of course, important in their spheres, but in the battles to be fought in a general European land war, the Cavalry, Artillery, and Infantry are by far the most important, and a more detailed consideration of the arms as used by these branches in the various countries will follow.

The main object of the Cavalry in all of these armies is to reconnoiter and obtain information of the enemy and the terrain on which he operates. For that purpose it is sent out ahead of the main army, and is therefore generally the first arm drawn into active engagement with the enemy's advance troops. During the fighting of the Infantry and Artillery it must be in readiness, in addition to its scouting duties on the flanks, to throw its support to wherever it may be most needed for the success of the Army.

The Cavalry is armed with a rifle or sword or both, and in some cases with the lance. They are called by various names, as in Germany: Hussars, Uhlans, Dragoons; Russia: Cossacks, Dragoons, Hussars; France: Cuirassiers, Hussars, Dragoons; Great Britan: Hussars, Lancers; Austria-Hungary: Dragoons and Uhlans. They are always mounted, and their ultimate training has in view their ability for long service in the saddle without rest.

The Field Artillery arm of a modern Army is undoubtedly the most important branch, next to the Infantry. In fact, it is probable that the success of a modern battle will depend on the superiority of the Field Artillery, and enormous sums of money have been spent with a view of providing field artillery guns and ammunition in each of the countries involved.

The two nations that have led in the development of Field Artillery are undoubtedly France and Germany. Each has followed its own line of development to a certain extent, but if reports contained in military magazines are correct, it may be assumed that the French Field Artillery is the more efficient.

The object of Field Artillery is to support the Infantry in its advances or its retreats. It aims to hit the part of the enemy which is most dangerous to the friendly Infantry and which would hinder its success. Since the enemy's Artillery would do the same thing, it is evident that a modern battle will generally begin with an artillery duel, and that whichever side is able to silence the other side's Artillery will have a tremendous advantage. In fact, until the enemy's Field Artillery is silenced an advance of the Infantry would be practically impossible.

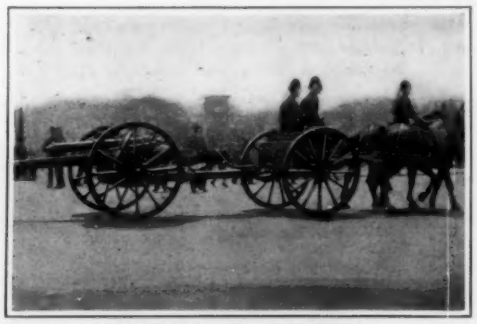
As the Infantry advances the Field Artillery must be in readiness to fire over the advancing lines and attack parts of the enemy's troops, or must be able to move with lightning rapidity to any other position where its fire is needed or is more effective.

A battery of Field Artillery is a tactical unit composed of from four to eight guns, and ammunition wagons, loaded with shell and shrapnel.

Since its first object is to destroy the enemy's Artillery, it will be seen that the longer the effective range of the guns is, the better will it be able to damage the enemy before the latter is able to reach it. On the other hand, in order to be able to shift its position quickly it must be light and able to be put into action easily. The three objects to be obtained, therefore are: Power, making possible accurate shooting at long ranges; Rapidity of Fire, and Mobility. The gun on which the various armies are depending more than anything else is undoubtedly what is called the light field piece, all of which are approximately 3-inch caliber. To apportion to the best advantage the various qualities desired in a 3-inch light field gun has been a difficult problem, and each country has developed its own piece differing from any other. As will be seen from the following table, the French are equipped with a heavier gun, firing a heavier projectile at a much higher velocity, than are the Germans. Since the energy of a projectile varies directly as the mass and the square of the velocity of the projectile, it is evident that the French projectile will be more powerful than the German. On the other hand, it will be more difficult for the French to haul their guns from place to place. The foregoing table gives the more important and interesting data for Field Artillery for various countries:

FIELD ARTILLERY OF THE EUROPEAN ARMIES.

Country.	England.	France.	Russia.	Belgium.	Germany.	Austria.	Italy.
Made by	England.	France.	Russia.	Krupp.	Krupp-Ehrhardt.	Austria.	Krupp.
Caliber, inches	3.3	2.95	2.95	2.95	3.03	3	2.95
Weight of projectile, pounds	18	15.9	14.3	14.3	15.1	14.7	14.3
Muzzle velocity, feet per second	1,600	1,740	1,945	1,630	1,500	1,630	1,675
Rate of fire, shots per minute	20	20	20	30	20	25	30
Maximum effective range, yards	6,300	6,000	6,000	6,000	5,500	6,700	6,600
Muzzle energy, foot tons	320	334	360	258	236	272	260
Weight of gun and carriage, pounds	2,690	2,500	2,300	2,300	2,080	2,350	2,200
Number of guns in a battery	6	4	8	6	6	6	4
Rounds of ammunition per gun with a battery	176	312	212	242	126	168	312



English field gun on the march.

By remaining velocity is meant the velocity of the projectile at any part of the range; for example, a 15-pound projectile fired at 1,700 feet per second muzzle velocity has a remaining velocity of 960 feet at 2,500 yards range, 310 feet at 5,000 yards, etc.

For the same initial velocity the remaining velocity will be greater for the greater weight of the projectile and same caliber. Similarly for the same weight of projectile the remaining velocity will be greater for the greater initial velocity. Consequently, since the weight and initial velocity of the French are greater than that for the German, it will be seen that the remaining velocity for any range and therefore the striking energy of the projectile will be greater for the French gun than for the German.

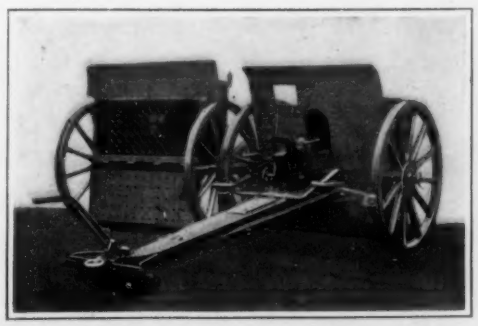
This is of great importance since it enables the French to direct a more effective fire at long ranges, and the shell as well as shrapnel of the French will be more destructive both against earthworks and personnel. On the other hand, if the target is changing quickly and it is necessary to shift the gun, the Germans, having 500 pounds less to move, will be able to do this more quickly, and thereby have a great advantage over their adversary.

The range given in the table is the maximum effective range and is generally the range obtainable by the maximum elevation of the gun on its carriage, about 15 degrees. The maximum range obtainable for any gun is for about 43 degrees elevation, after which the ranges become shorter. The range for all of these guns that could be obtained with the guns at 43 degrees elevation would be between 9,000 and 10,000 yards, but since firings at such long ranges would have little, if any, effect, no efforts have been made to construct a carriage for such elevations, unless it is intended to use it for balloons also.

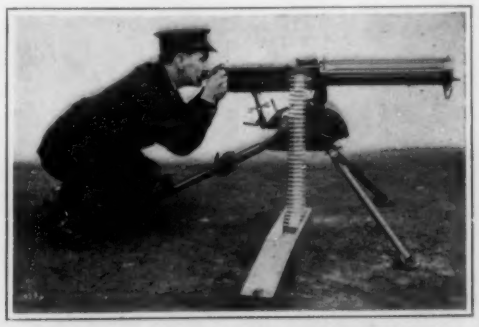
In actual battle the guns of a battery are lined up and one loaded caisson is placed next to each gun. The entire battery is behind cover, and generally cannot see the targets. The fire is directed by each gunner aiming on a designated aiming point, with an instrument set at a given deflection, so that the gun will actually point at the target. This deflection is calculated by a triangulation method by the Battery Commander, who is located some distance away from the battery either on elevated ground, on a ladder, or in a tree. The German system of obtaining the deflection is to measure the angles carefully, by means of instruments, thereby attempting to make the first shots effective; while the tendency of the French system is to estimate the first deflection, fire quickly, and by observing the shot, make necessary corrections for succeeding shots. The ranges are obtained by self-contained base range-finders, which are accurate within 200 yards for 5,000 or 6,000 yard ranges.

Within the last few years the subject of equipping the Field Artillery wtih larger caliber siege guns and howitzers has been given extended studies.

The object of howitzers is mainly to fire a heavier projectile with a lower velocity at a much higher elevation and longer range. Assume, for instance, the



Belgian field gun as it appears in action.



Type of Maxim machine gun used by English.

enemy's Infantry entrenched behind embankments. With a high velocity the trajectory of the projectile for a given range is very flat, so that the troops would be able to sit behind the cover, and have all projectiles either strike the embankment or pass over their heads. For this emergency a battery of howitzers is called into action. By reducing the charge the projectile may be started at a higher elevation, which causes the projectile to fall to the ground in a much more nearly vertical path, and enables it to be dropped back of the embankment. As a concrete example, assume the enemy's Infantry behind earthen cover at 3,000 yards.

The slope of fall of the French projectile at that range would be about 7 degrees or 1 on 8; this gives a considerable space behind a wall that would be practically immune from the artillery fire.

By calling a 4.7-inch howitzer battery for this work, the Artillery Commander may fire a 60-pound projectile with 900 feet per second muzzle velocity, which would give him at 3,000 yards a slope of fall of 1 on 4.3, or he may remove some powder from the charge and fire the projectile at 620 feet per second muzzle velocity, which would give him a slope of fall at 3,000 yards of 1 on 1.8, with which it would be practically impossible for the enemy to remain behind the cover.

Due to rapid advance of science within the last few years, another element must be contended with in the next war. The aeroplane, which, a few years ago, was considered an impossibility, is to-day one of the best means for obtaining accurate information concerning the enemy.

There are two means of combating a flying machine. Many military students contend that the way to destroy an aeroplane is to put a machine rifle in another aeroplane and attempt to combat it in the air. This will probably be the method followed in a modern war at the present time. Another means is to provide field artillery guns able to fire in the air, and many balloon guns of this type have been tried out by various countries. One notable cannon of this type is the Deport field gun, which is so arranged that it can be used as a field artillery gun for low targets, but may be trained for aerial targets as well.

There are a number of difficulties connected with firings against balloons or aeroplanes, and extensive experiments have been carried on in various countries for the purpose of solving this problem. The large ordnance manufacturing concerns of the Krupp and Ehrhardt companies, in Germany, have designed and manufactured guns firing 3-inch projectiles mounted on automobiles or on wheels; but so far no definite conclusions have really been reached as to the most effective manner of firing at balloons.

Among the difficulties experienced is the fact that the aeroplanes move very rapidly, making it difficult to follow them through the sights of the gun. Another difficulty to be encountered is the fact that the required angle of departure for a projectile to reach a certain range varies as the target moves above the horizon. For instance, a target on the same level with the gun at 5,000 yards range may require an angle of departure of 11 degrees; while if this target should be located 45 degrees above the horizontal the super-elevation, which is the elevation of the gun above the line drawn from the gun to the target, would be only 4 degrees or 5 degrees. If the aeroplane should be the same distance but vertically above the gun, no elevation over the direction of the line of sight would be necessary.

It is also a difficult matter to estimate the distance to these balloons, and the use of range-finding instruments, due to the rapid movement of the targets, is at times almost impossible. In some cases experiments have been carried on with a view of firing projectiles with burning tracers attached to them. These tracers, by burning in the air, will show the path of the projectile, and will show how close the projectile may be to the target.

That rifles or small guns can be fired from aeroplanes has been demonstrated. While these guns would probably not be very effective against troops on the ground, there is small doubt but bombs dropped from balloons would be a very dangerous inconvenience for the enemy. Experiments carried on have shown that these bombs can be dropped with great accuracy from a considerable height, and a sighting arrangement for dropping them has been fairly well perfected. The principle of such a sighting device is to set the sight at a certain elevation, depending on the speed of the aeroplane and its height, aim at the target, and release the bomb as soon as the sight is on the proper target.

There is yet another field of use for field artillery. In Germany and France there are a number of cities which are protected by extensive fortifications. In addition, temporary fortifications will be thrown up by each side for the purpose of protecting important strategic places. To destroy these fortifications and drive the troops out, the siege artillery is brought into action. The guns for this purpose are brought up on wheels, as in the case of the smaller calibers, but are placed in more or less permanent positions for action.

There is no standard proportion of number of these batteries used in the various armies. The weights of the projectiles and velocities are more or less the same for all, and for Germany and France are about the following:

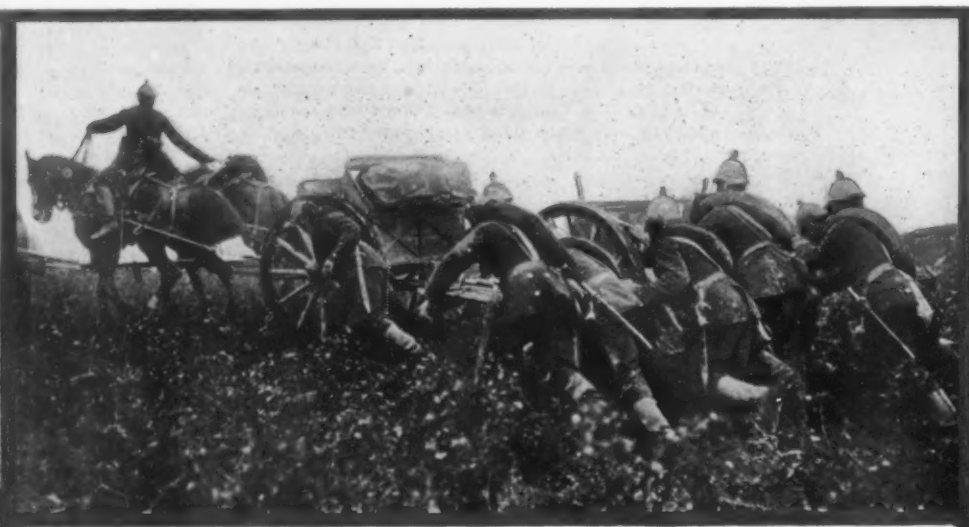
7.6-inch caliber, firing a projectile weighing 240 pounds with 1,100 feet per second velocity.

9.5-inch, with a 480-pound projectile and 1,000 feet per second velocity.

10.3-inch, with a 700-pound projectile and 1,000 feet per second velocity.

While it is probable the success of a battle will depend to a large extent on the support of the field artillery, it is certain that the principal and most important arm is the infantry, which in practically every case must decide the final issue. The cavalry may be the first to be drawn into a battle, and the Artillery may destroy the enemy's artillery, but a battle is never

Watching effect of fire.



German field battery taking up new position. The German field gun weighs 500 pounds less than the French, and is therefore more easily moved. But the French piece is more efficient. Its range is longer, and it hits harder.

Watching effect of fire.

German 11-inch siege gun in firing position.

Balloon-repelling gun on automobile in action.

Another object of these heavy cannon is, that a battery can be put in position to sweep a large field, and with its long ranges prevent the enemy's lighter artillery from coming within effective reach.

The velocity of these howitzers is practically the same for all countries, and is about 900 feet per second for the longest zones, while the calibers are approximately 3.8-inch with a 30-pound projectile, 4.7-inch with a 60-pound projectile, 6-inch with a 120-pound projectile.

The number of rounds that will be fired during an ordinary battle can only be imagined. We have data from the Russo-Japanese War showing that at Ljaopan one battery fired 2,600 rounds in one day, while another fired 3,304 rounds, making for each gun about 413 rounds in one day. This was not an uncommon occurrence, and it shows the expense involved in carrying on a modern war.

The most common projectile of the 3-inch caliber is the shrapnel, which is in itself a gun, arranged by time fuses so that at the desired height it is made to burst, shooting forward out of a shell 250 lead balls, each effective to kill a man.

won until the infantry has driven back the enemy's lines.

The usual mode of advancing for the infantry is to deploy them in a line with a long interval between each soldier. This, naturally, is for the purpose of offering a smaller target for the enemy. It makes it more difficult, however, for the leaders to keep as good control over the men, and for that reason one of the objects of field artillery is to make the enemy's troops deploy early.

The infantry soldier is armed in all the countries with a rifle and bayonet. The rifle is the weapon upon which reliance is placed, the bayonet being used only as a last means, when in a hand-to-hand encounter with the enemy.

The rifles of the various countries differ in certain qualities, but in general outline they are more or less alike. The following table gives the more important data about these rifles.

The qualities as regards weight of bullet and velocity as described for field artillery projectiles hold here also. By danger space as given below is meant that if the rifle is fired 12 inches from the ground and aimed at the middle of a target of a height of an average man, 68 inches, and an infantryman is anywhere inside of the limit of range given, the bullet would hit him. Beyond the ranges given there will be a space at about the middle of the trajectory where the bullet would pass over the head of a man, and where, therefore, he would be in perfect safety. It is evident that the greater the danger space the more dangerous will be the rifle to the enemy's troops.

Since about 1906 Germany and France have adopted the pointed bullet. With this the resistance of the air is greatly reduced and the ranges obtainable with the same velocity, weight, and caliber are greatly increased.

By increasing the velocity the danger space for any range is of course increased since the trajectory is much flatter, and for the same "kick" of the rifle a much more powerful bullet is obtained.

Probably every country has developed, or is developing, a semi-automatic rifle, which differs from the ones now in use in every army by the fact that part of the powder gases are used to open the breech block, eject the empty cartridge, and reload the rifle—all of which operations are now performed by hand. With a semi-automatic rifle the magazine can be emptied without moving the gun from the shoulder, and a great increase in the rate of fire can be accomplished.

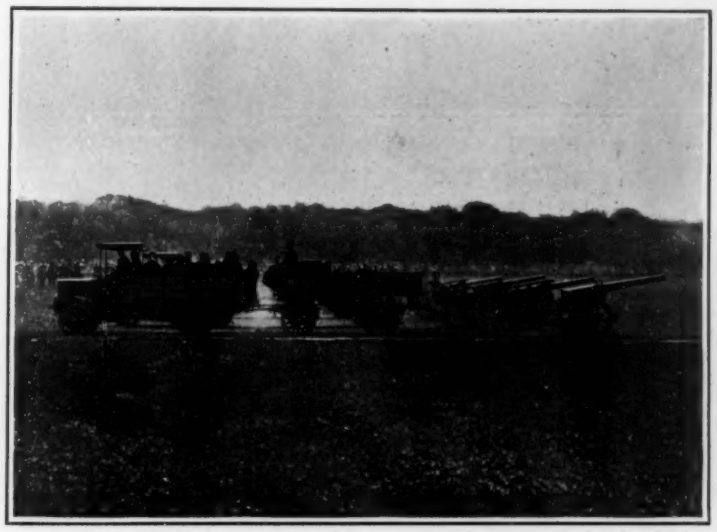
The opening of fire from the infantry will generally be delayed until accurate aiming is possible, unless it is desired to cause the enemy to deploy its forces earlier, and although the bullets are effective at 1,500 and 2,000 yards range, the real fighting will not begin until at much closer ranges.

With each regiment of infantry there belongs a platoon or company equipped with two or four machine guns. These machine guns generally fire the same ammunition as is used for the rifle of the army, but fire it semi-automatically from clips or belts containing 30 to 250 rounds each.

The most notable of these machine guns are the Hotchkiss (French) and Vickers (English), the former firing from clips containing 30 cartridges, and the latter firing from belts containing 250 cartridges. The rate of fire of these guns is about 400 to 500 shots per minute.

These rifles are transported either on light wheeled mounts or packed on mules or horses. Their prime object is to be able to take up a position and be able to deliver an overwhelming volume of fire where needed.

The coast artillery was mentioned above as not being very well developed in European countries. This, undoubtedly, is due to the dependence they place in the battle fleets and the short shore lines. The guns in the coast fortifications are of comparatively small caliber, none exceeding 9.5 inches. These guns are mounted on disappearing carriages, but cannot be very effective against the large calibers as for instance the 13-inch and 14-inch guns on a battleship. It is possible that every country feels that with their land forces, they are perfectly able to repel any landing party that might desire to venture ashore.



Battery of French field guns, hauled by automobile.

RIFLES USED BY THE EUROPEAN ARMIES

Country.	England.	France.	Russia.	Belgium.	Germany.	Austria.	Italy.
Designation	Lee-Enfield	Lebel	3-line Nagant	Mauser	Mauser	Mannlicher	Mannlicher
Magazine system	Detachable vertical box	Tube in fore end	Fixed vertical box	Detachable vertical box	Fixed vertical box	Fixed vertical box	Fixed vertical box
Number of cartridges in magazine	10	8	5	5	5	5	6
Weight without bayonet	8 pounds 10.5 ounces	9 pounds 3.5 ounces	8 pounds 15.5 ounces	8 pounds .5 ounce	9 pounds	8 pounds 5.5 ounces	8 pounds 6.5 ounces
Caliber, inch	.303	.315	.300	.301	.311	.315	.256
Maximum effective range, yards	2,100	2,187	2,096	2,187	2,187	2,132	2,187
Bullet, shape of nose	Round	Pointed	Round	Round	Pointed	Round	Round
Weight, grains	215	198	214	219	155	244	163
Muzzle velocity feet per second	2,060	2,380	1,985	2,034	2,882	2,034	2,395
Material of envelope	Cupro-nickel	No envelope. Bullet of copper zinc	Cupro-nickel	Cupro-nickel	Nickel-steel	Steel	Cupro-nickel
Ranges for which the entire space under trajectory is a danger space for infantry, yards	640	640	620	640	610	650	750

A Graeco-Roman Era in Egypt

AN exhibition of particular interest to Egyptologists was recently opened at the rooms of the Society of Antiquaries, Burlington House. Here have been collected samples of the discoveries made at Antinoë and Abydos during the past year. The work at Antinoë is most largely represented, and the finds throw considerable light on the life of the inhabitants of the town, especially during the fifth and sixth centuries, A. D.

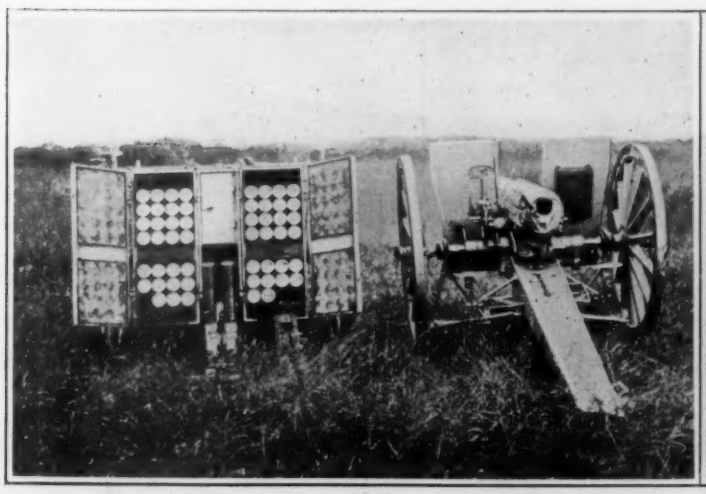
Antinoë was founded in the latter part of the year 130 A. D., while Hadrian was voyaging down the Nile. The immediate cause of the founding, we are told, was the loss by drowning near by of the Emperor's favorite, Antonius. The bulk of the papyri discovered is in Greek, but a few are in Latin and a considerable number in Coptic.

One valuable find of the year was a number of pages of Theocritus dating from the fifth or sixth century A. D. This is practically the only example of a Theocritean MS. which Egypt has yet provided, and the fact that it is at least seven centuries earlier than the earliest of the mediæval MSS. makes it a find of considerable importance to scholars.

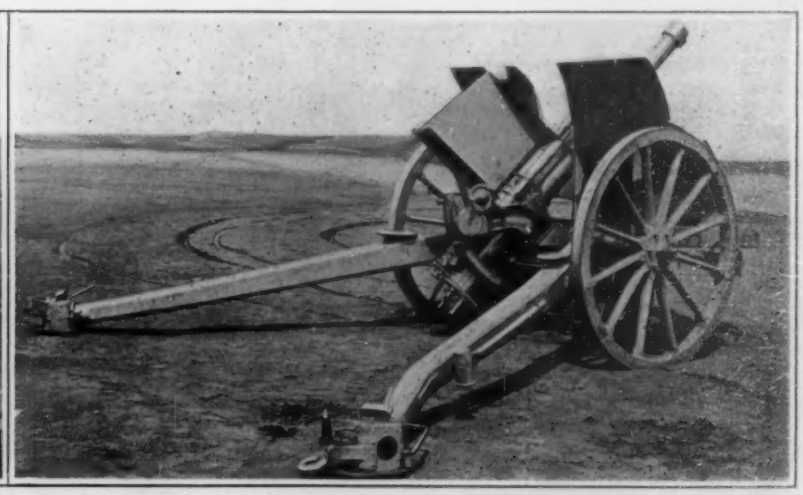
Shorthand appears to have been in existence in those early dates. One fragment not only gives a Latin alphabet with the letter names in Greek, but lists of words with their shorthand equivalent. Particularly valuable also are a number of Coptic woven tapestries which run from the third to the seventh centuries. Some pieces of woven silk must have been among the earliest that occur either in Europe or Egypt. They are supposed to date from the sixth century, and silk was only introduced into Europe from China about 550 A. D.

Sir Frederick G. Kenyon, who opened the exhibition, remarked that the finds were largely the work of Mr. J. de M. Johnson. They illustrated the daily life of Græco-Roman Egypt in the early centuries of our era. Particularly valuable were the Latin manuscripts, which were very rare from Egypt.

American Motor Population.—According to the latest authentic figures there are now in the United States 1,548,350 motor cars. The figure includes both gasoline and electric vehicles for both pleasure and commercial purposes. This figure is the total registration up to July 1st only, so that by the end of the year it undoubtedly will be considerably larger. The registrations for the three previous years are as follows: 1913, 1,253,875 registered; 1912, 1,010,483 registered; 1911, 677,000 registered. As might be expected, New York State leads with a total registration of 140,653 cars. Nevada is last with 1,265 cars registered.



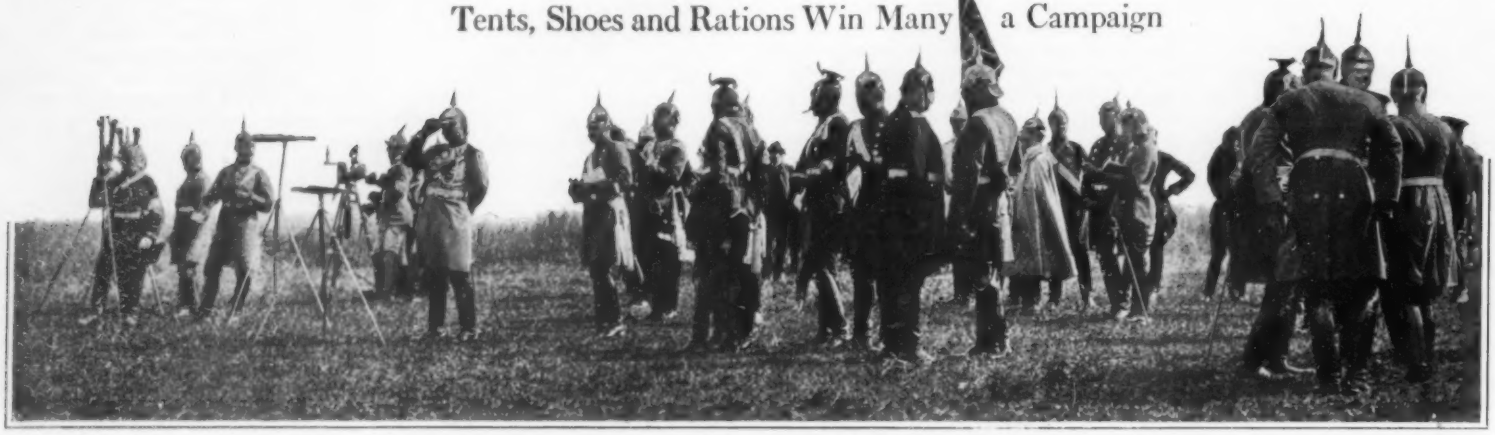
French field gun, with loaded caisson, in action. Traverse of gun is 8 degrees.



French Deport field artillery and balloon gun. Permits traverse of 45 degrees without moving carriage.

Feeding the Man on the Firing Line

Tents, Shoes and Rations Win Many a Campaign



The German Emperor and his staff observing field operations.

NO business man would undertake a new enterprise without first preparing a scheme or plan of operations; and as an army is a city appearing suddenly in a country, and changing its location each day, thus either completely breaking its line of supply, or requiring the sudden extension of the same, and perhaps in a new direction, the necessity for the formation of plans for the operation, and particularly the plan of supply, is self-evident.

The fighting capacity of the men of all civilized nations is about the same, and when armies equal in numbers, discipline, and effectiveness are opposed, and are each commanded by masters of the art of war, that army which has the best conceived and best executed plan of supply will have the best chance of achieving victory.

The art of war is usually divided into two parts: *Strategy*, which is the art of disposing and moving troops over an extended theater of operations; and *Tactics*, the sphere of which is limited to the field of battle.

Ordinarily, when a campaign is studied, inquiry is first made concerning the forces engaged, their locations at the commencement of operations, and the position of their reserves; the roads selected for the forward movements and for the strategical concentration; the obstacles to be surmounted and the preliminary engagements preceding the battle which frequently terminates the campaign.

Next, entering upon the domain of *Tactics*, the *terrain* fought over, the order of battle adopted, the movements executed at different periods of the action, the employment of special arms of the service, the results achieved, and, if it occurred, the retreat and pursuit of the defeated army.

A campaign can, furthermore, be studied by ascertaining the preparations made for it; how the troops were mobilized; how the supplies of all kinds were provided prior to the commencement of active operations, the manner of transporting them from the centers of production to the base of operations and how they were stored there; how the troops lived; how the sick and wounded were evacuated; finally, the precautions taken promptly to fill the great gaps which so rapidly occur in the *personnel* and *materiel*.

When we study one of those campaigns which have become classic, as those of Bonaparte in Italy in 1796 and 1800; or of the campaigns of 1805 or 1806; or of the campaign of 1866 in Austria, the brilliant success and the importance of the results achieved in a short time impress one. Upon more mature reflection, it is apparent that those great military and political achievements have not resulted in consequence of a caprice of fortune, but have always been preceded by most minute and careful preparation, made with great prudence, profound foresight, and a thorough knowledge of all the requirements of the armies.

That part of the art of war closely connected with *Strategy*, which alone can facilitate, or even render practicable, the most hazardous and the most successful combinations, is the administration of armies. It is the art which is charged with providing for all the wants of the troops, and which husbands their strength so that without becoming weakened by exhaustion, they are enabled to attain a distant objective, concentrate there, and finally strike a decisive blow.

To provide for the wants of the troops every army has one or more administrative departments charged with the procuration, custody, and distribution of certain varieties of supplies which are essential to keep the troops in health and strength, and which provide them at all times with everything that is indispensable for the furtherance of the plan of campaign.

In forming a plan of supply for a particular campaign the following points must be carefully considered: the resources of the theater of war and the facility of utilizing the same; the time of year and climate; the nature of the war, whether offensive or defensive; the length of the line of communications; the rapidity of the movements; the propinquity of the enemy; and the temper of the inhabitants.

The national country must provide the supplies for its armies. This is particularly important now, as it has been held that provisions and foodstuffs of ordinarily innocent use, which are usually only *conditionally* contraband, may become *absolutely contraband* of war when actually and especially destined for the military or naval forces of a belligerent.

The right of armies to take from the country all that they require for their sustenance is indisputable, though we usually understand the expression "living upon the country" has direct application to an enemy's country. Military necessity, as understood by all civilized nations, permits the enforcement in an enemy's country of all those measures which are indispensable to facilitate and assist in the conduct of the war, and which are lawful according to the modern law and usages of war.

The preparation, therefore, must extend to an elaborate study of the resources of the home country and of a probable theater of operations. In some of the great powers this work is carried out through the co-operation of the various civil authorities whose duty it is to make instant report of any change in the supply situation in their district. Statistical data and supply maps are prepared showing:

The principal production of the country; the distribution of the available resources; the importance of the last harvest; the amount of the exports of same; the amount locally consumed; the number and kind of meat cattle; the number, motive power, daily capacity, and location of the flour mills; the number and average yield of the bakeries; the number and location of the abattoirs and meat-packing establishments; the number

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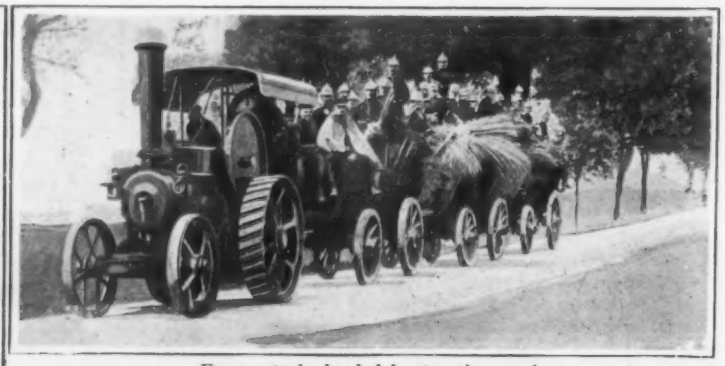
Foraging squad returning to camp with a drove of steers.



Forage train hauled by traction engine.

A Russian automobile military kitchen.

of draft animals; the means of transportation, railways, steamboats and ordinary roads, and their capacity; the number of the inhabitants, urban and rural; the character of the imports and exports; the supply and character of the potable water; the fuel used and its abundance.

In order to assure the continuity of the service of supply, that is to say, the relation between the troops in the field and the centers of production in rear of the army, the work performed by the administrative departments is divided into three distinct spheres of action, viz.:

1. The service performed in rear of the army, established in the national territory or in the governments of the occupied countries for the purpose of collecting the resources and providing means for the supply of

2. The service of the Line of Communications; the duty of the commander of which is to provide for the replacement of the stores consumed by the army, and the transportation, subsistence, and quartering of all troops, prisoners, sick and wounded passing over the line, and also provide for its protection.

3. The supply of the troops in the field during active operations.

These three services are entirely separate, but work in conjunction with each other to carry out the main object for which they are created—the supply and maintenance of an army in the field.

The success or failure of the campaign depends upon the proper operation of the service of the Line of Communications, and this important position is always assigned to a general officer of recognized ability and discretion. He is assisted by a large and numerous staff to enable him to carry out the varied and multitudinous duties assigned to him, and, in addition, has a competent force of all arms of the service to preserve order along the Line of Communications, guard the depots of supply, and protect the line from attacks by the enemy. Such officer is subordinate to the commander of the troops in the field, but his duties and responsibilities are second only to such officer.

The commander of the Line of Communications must then see that his depots are adequately supplied, and must forward each day to the troops the necessary supplies for man and horse, and likewise care for the evacuation of the sick and wounded, and the custody and care of the prisoners. To enable him to do this, all the necessary field equipments are provided; for instance, a Field Bakery Company, and equipment for each Division supplied by the Line of Communications. The Field Bakery in our Army consists of twelve knock-down bake ovens with all the necessary equipment for producing bread and the tentage in which to install the dough troughs, and shelter the men. Each oven is capable of producing 2,500 rations of garrison bread per diem, or 1,500 rations of field bread; this is bread produced in such manner that it has not as great a "pile" as ordinary (or garrison) bread, and being baked in a much slower oven, and no loaves allowed to touch (or "kiss") is completely enveloped with a good, thick crust, thus permitting the bread to be readily shipped in wagons; and its freedom from moisture renders it possible to be kept in good condition for a week or ten days. So that each field bakery can produce daily 30,000 rations of garrison bread, or 18,000 rations of field bread, sufficient to supply a Division.

The supplies an army carries with it may be divided into two classes: those carried by the troops themselves, and those which are carried in the trains.

The troops having to march many miles a day, starting early in the morning and probably not completing the march until late in the afternoon, would suffer greatly from lack of food if compelled to await the arrival of the train carrying the same. Therefore it follows that, if troops are to be fed in the field, they must carry rations with them, and the ration consumed during the day must be replaced by the train at night.

A ration is the allowance of food for one person for one day, and comprises various articles termed components. It is interesting to note that the Turks in the fourteenth century first established the allowance of a soldier's daily ration, and in the same century first had regularly organized supply trains to follow their troops.

Each man carries two days' rations, and the unconsumed portion of the day's ration issued the night before, for the noonday meal.

The transportation attached to organizations is grouped under the following heads, i. e.:

(*a*) The trains assigned to organizations smaller than a brigade, designated combat and field trains, respectively. The ration section of the field train carries two days' field, one day's reserve ration, and for each animal two days' grain ration.

(*b*) The trains assigned to divisions, designated ammunition, supply, sanitary, and engineer trains, respectively.

The supply train of an Infantry Division carries two days' field and grain rations. In the late afternoon or at the end of a march or close of a combat, the division commander directs the *field* trains to move up immediately in rear of the troops, and informs the commanding officers of organizations that one day's rations have been ordered to a designated place. An orderly is sent to that place to conduct the wagons to the organization; after being unloaded they return immediately and join the grouped portion of the ration section. That same night, or early the following morning, the empty wagons are refilled from the supply train, and this latter secures a renewal of its supplies from a designated point on the Line of Communications, or is reloaded from a train pertaining to the Line of Communications, if the distance from the end of that line to the zone occupied by the troops is so great as to warrant the use of a train.

There are two methods of supplying an army in the field:

1. By consignments of supplies forwarded by the service of the Line of Communications and distributed as above briefly indicated; and

(*Concluded on page 190.*)

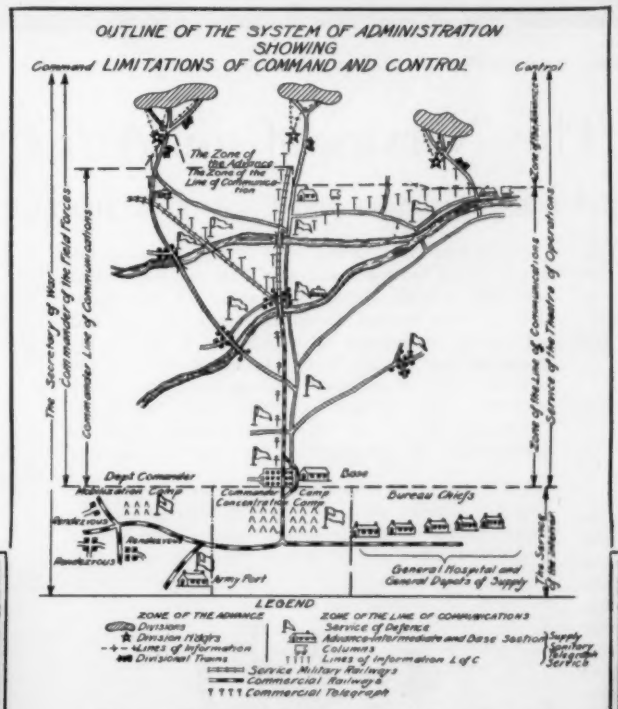
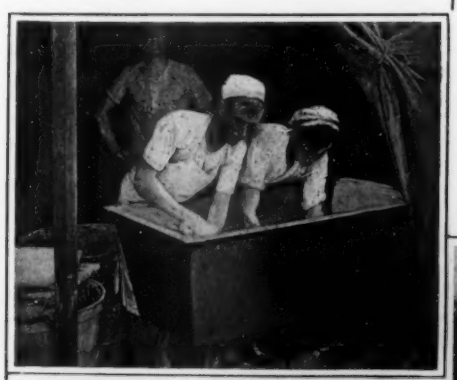
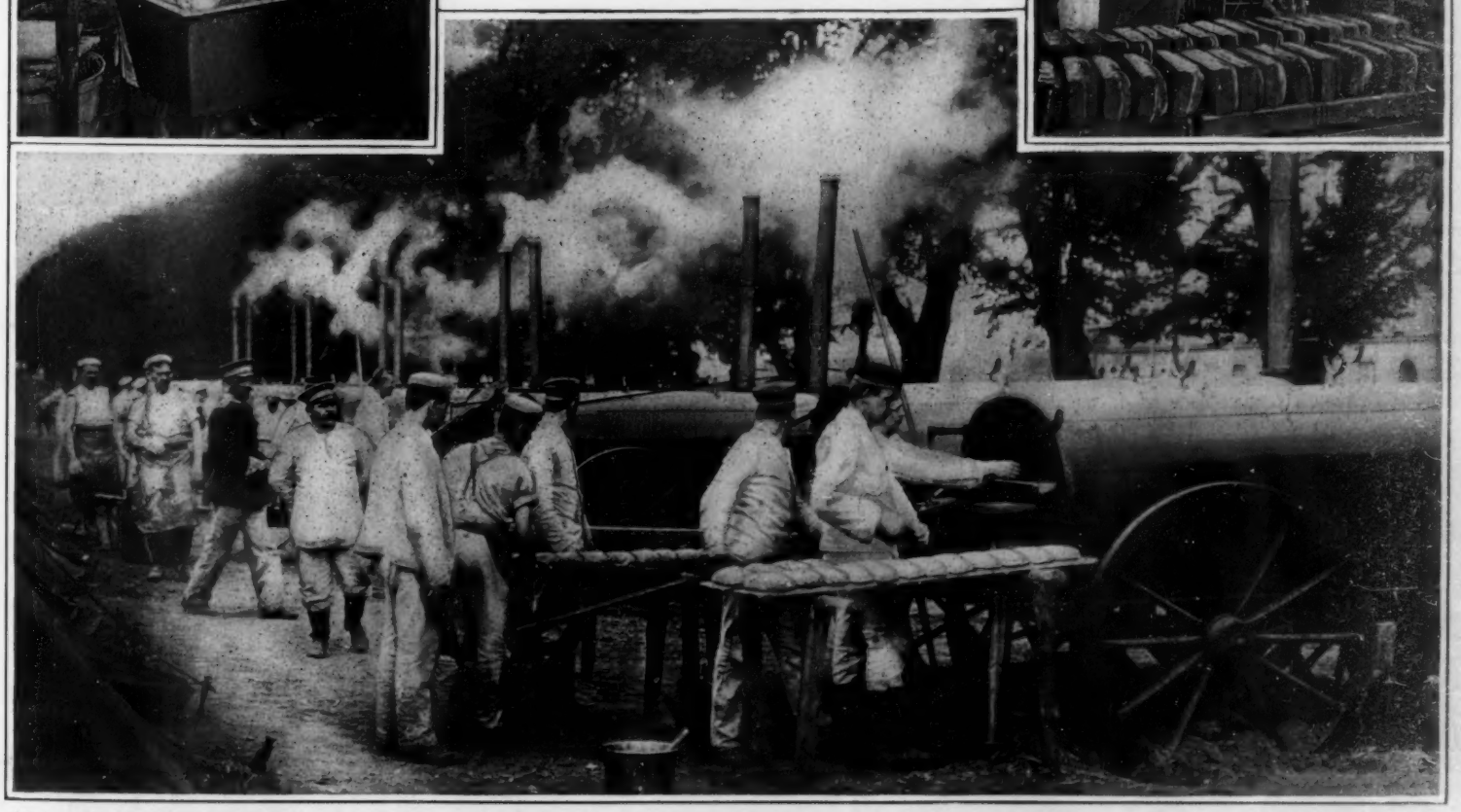


Diagram showing method of control of an army of 100,000 men in the field.



Mixing the dough for army bread.



Bake ovens of German Commissary Department. Capacity, 16,000 loaves per day.

Canvas storage tent for army bread.

Flashing messages from a heliograph station. Maximum range in clear weather, eighty miles.

The Nerves of an Army

How the Commander-in-Chief Sees and Controls a 100-Mile Battle Line

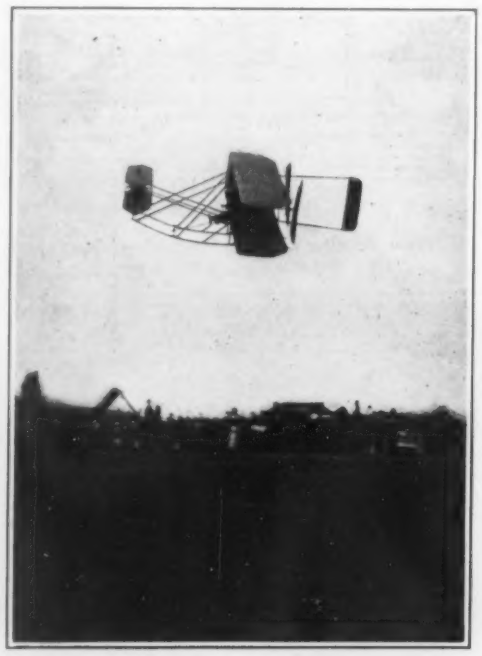
BY law and regulations the function of the Signal Corps in our Army is defined to be "the collection and transmission of information for the Army by telegraph or otherwise." In comparison with other arms, it may be said that while the cavalry, artillery, and infantry are the bones, sinews, and muscles of the body militant, the Signal Corps is its nervous system.

The harmonious action of all parts of the military machine depends primarily on the quick and precise delivery of information and orders, and it is upon lines of information that a commanding general depends to carry this information from the units of his force, and to return his orders to them. These lines are the means by which military information is transmitted, whether by wire telegraphy or telephony, radio-telegraphy, visual signals, messengers, or aeronautical craft.

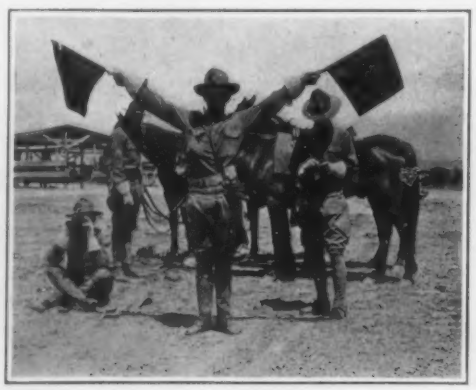
Modern war involves the employment of huge armies distributed over an extensive terrain. With long-range and rapid-fire weapons has come a necessary dispersion of troops, and the consequent extension of the lines has threatened the efficiency of command by the general, and made increasingly difficult that unity of action so necessary to the successful employment of his forces. The adoption of neutral-colored uniforms and the concealment afforded by modern means of intrenching make still more difficult the delivery of orders by staff officers and messengers. The apparent emptiness of the modern battlefield has been frequently remarked by observers in recent maneuvers and wars. Under present conditions in warfare, it may be said therefore that the speedy transmission of information, a prompt decision on its receipt, and celerity of movement are more than ever necessary. The space and time factors have greatly increased in relative importance. It devolves particularly on the Signal Corps to provide for this speedy transmission, and this is accomplished by the use of electric communication in the field. The telegraph and telephone have become so much a part of our daily life in business and personal relations, that we scarcely realize our reliance upon the service rendered by the elaborate system of wires, apparatus, and well-trained personnel. To reestablish as far as possible such service under field conditions, is one of the objects of the Signal Corps. It is obvious that, under such conditions, an entirely new line of equipment is required, and that men must be specially trained to use it.

In providing proper organization and supplies for military lines of information, the work to be performed may be considered as divided into three classes. First the maintenance and operation of such lines from the Capital of the nation to the headquarters of the Army in the field; second, the construction, maintenance and operation of radio-telegraph stations and semi-permanent telephone and telegraph lines from the headquarters of the Army in the field forward to the various divisions at the front, also the provision of the necessary camp telephone and telegraph lines within the Army; third, the establishment of the temporary lines in the combat zone included within the active field operations of the divisions, consisting largely of insulated wires laid on the ground and the radio-telegraphic and visual signal communication for tactical purposes.

In the first class named, most of the equipment required would be that taken over from the commercial telegraph systems, which under stress of war conditions, at least in part, would have to be manned and operated in the interest of the nation. A military organization and control would be substituted for the civil one, and the ordinary telegraph apparatus, either land lines, cable, or radio, would be used. The Signal Corps soldiers in this zone of operations could be quickly recruited and organized from the operators and



The first aeroplane adopted by any army.



Two-arm flag semaphore signaling. Rapid method for short distances.

linemen of the country, and they would require but little preliminary military training. As the systems would be in territory well back of the theater of field operations, the established roads and railroads would simplify problems of transportation and supply.

In the second class, viz., communication from field headquarters to the front, the work performed is in territory where recent military operations make it necessary to organize and equip for conditions quite unlike those for electrical communication in peace times. The wire lines must, in general, be hastily built with light wire supported on temporary small poles called "lance poles," and the radio apparatus must be of a portable variety. Telegraph apparatus employed on high resistance and poorly insulated wire is of the special type which has been developed in our service, requiring only a few dry cells for operating over long and difficult lines. A very compact and portable form of camp telephone has been devised to meet the requirements of rough field service; also a folding type of telephone switchboard of great ruggedness and simplicity for use in field headquarters and camps. All this equipment of light poles, wire, and instruments has been divided up into proper proportions for the different requirements, and special wagons have been provided to insure its transportation in accompanying the field army or divisional headquarters. The officers and men designated for this work are organized into Telegraph Companies and Telegraph Battalions. The sections of these companies are each equipped and drilled to install a well-defined part of the system. The telegraph section can establish and operate a certain amount of line with the stations thereon. The telephone section is equipped to put in a camp central station with the wire and telephones for a large camp. The officers and men of the telegraph battalions must be well trained, not only in their technical, but also in the soldierly duties pertaining to active field service. As at present authorized, a telegraph battalion in our service consists of two companies, each composed of six sections, three of the sections being equipped for telegraph and three for telephone installation. The company consists of four officers and one hundred and thirty-nine men. A telegraph section requires two wagons, and a telephone section three, for its technical equipment.

A class of duties falls to the lot of the Intelligence Service troops serving in the zone in front of the divisions, that requires an entirely special equipment. To them is assigned the task of maintaining lines of information during action, hence these have been called "tactical" or "combat" lines. The wire lines consist of insulated wire laid on the ground, for it is only such lines that can be laid and used to follow the rapidly changing phases of the conflict. As each infantry brigade and the artillery goes into action, it is followed by a reel cart laying wire from division headquarters. The strong flexible wire employed is an insulated one of stranded steel and copper, and can be laid from the cart at a gallop, and almost as quickly reeled up on the drum by means of a chain and sprocket gear. For emergency use and over short distances, a much lighter wire can be laid from a hand reel. These wires

being of high resistance, and frequently leaky, a special instrument known as the buzzer has been developed for operating over them. This remarkable instrument, which was largely developed by our own Signal Corps, contains in a metal-lined leather case, a small dry battery, induction coil and interrupter, key, telephone receiver, and telephone transmitter. When the key is pressed, the interrupter operates, and sends out from the coil an alternating current, which traversing the line and distant telephone receiver gives out a sharp note. The intermittent current produced by the sending key, becomes the dots and dashes of the Morse alphabet. By pressing a button on the side of the transmitter, the instrument at once is transformed into a field telephone. Owing to the sensitiveness of the telephone receiver, the intense buzzing sounds sent out as Morse telegraph signals are audible over an incredibly bad line. For example, it has been worked successfully over twenty miles of bare wire laid on the ground in rainy weather. It can be made to work over a wire which has been broken, and the ends left lying fifty feet apart on damp ground. The whole apparatus is reduced to practically the size of a field-glass case, and weighs about five pounds, rendering it readily portable by means of a strap over the shoulder. It is the ideal instrument for field telegraphy or telephony over the combat lines laid by the reel cart.

In addition to the need for communicating from division headquarters to the infantry and artillery brigades, the divisional cavalry requires means for reporting back what its patrols and scouting parties ascertain. It would be inadvisable to hamper the divisional cavalry's movements with wire connections of any kind, so the light field radio pack sets have been devised to accompany the swiftly moving cavalry. In addition, near division headquarters, a more powerful radio set in a special pintle-type wagon, is always ready to set up and communicate with the cavalry pack set or others. The radio pack set, as developed by the Signal Corps for our service, consists of three main parts—the operating chest, the hand-rotated alternating generator, and a sectional mast with the aerial wires, or antenna, attachment. The whole outfit, with tent and accessories, makes moderate loads for and is carried on three mules. With easily manipulated strap attachments, the set can be made ready for use by the mounted section in one minute from the time a halt is ordered. This includes unpacking, putting up the sectional forty-foot mast, attaching the operating chest, and getting the handpower generator connected and sending started. The little generator develops about 0.3 kilowatt, and the range of operation with another similar pack set is about twenty-five miles under ordinary conditions. The wagon type of radio apparatus derives its power from a gasoline engine, the alternator develops about two and one half kilowatts, and a sectional mast eighty feet high is employed. This can be put up and the set operated in fifteen minutes. The range under ordinary conditions is about one hundred and fifty miles.

In addition to electrical equipment, the Signal troops serving with the division are supplied with signal flags, heliographs, and acetylene lanterns for day or night visual signaling. The larger signal flags are used to transmit messages by the "wigwag" system, white with a red center for use against dark backgrounds, and red with a white center when signaling against the sky or light background. The groups of right-left-front signals correspond to letters, and with a powerful glass may be read at distances of ten miles. The small semaphore flags are used in the hands in pairs, and as the combinations in positions are simultaneous, signaling is performed at considerable speed, but owing to the small-sized flags, only over comparatively short distances.

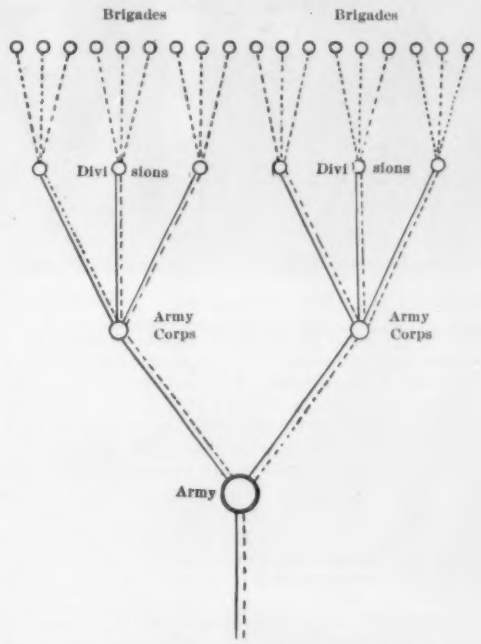


Diagram showing method of gaining intelligence and sending orders between the fighting line and headquarters of an army during an engagement. Dotted lines are buzzer or telephone; full lines, telegraph.

The heliograph consists of either one or two small mirrors mounted on a strong tripod, and by means of screw adjustments may reflect the light of the sun to the distant station in any direction desired. With the instrument adopted in the Signal Corps, the reflected rays are controlled by a shutter made up of movable blades, operated with a key like a telegraph key and mounted on the tripod. The long and short sun flashes, which may thus be sent, correspond to the dashes and dots of the Morse code. With the four-inch square mirror used, signals have been sent eighty miles. The disadvantage of the heliograph is that it depends upon sunlight being available at both stations.

The acetylene lantern is, in effect, a small acetylene searchlight like those used on automobiles. The lantern is mounted on a heliograph tripod. By means of a tiny pilot flame, the main acetylene jet is lighted when a key is depressed. The flame is extinguished when the key is raised. Thus flash signals may be transmitted similar to those sent by the heliograph. The range of this small lantern is about twenty miles on a favorable night.

The organization which employs the appliances just described in the zone of divisional operations, is called the Field Battalion. This is made up of two companies; one called the Wire Company, the other, the Radio Company. The first consists of four sections, each equipped with a wire cart, field wire, buzzers, and visual signal apparatus; the second of three pack radio sections and one wagon radio section, using the types of field radio apparatus described; it is also supplied with visual signal apparatus. Each company has three officers and seventy-five men.

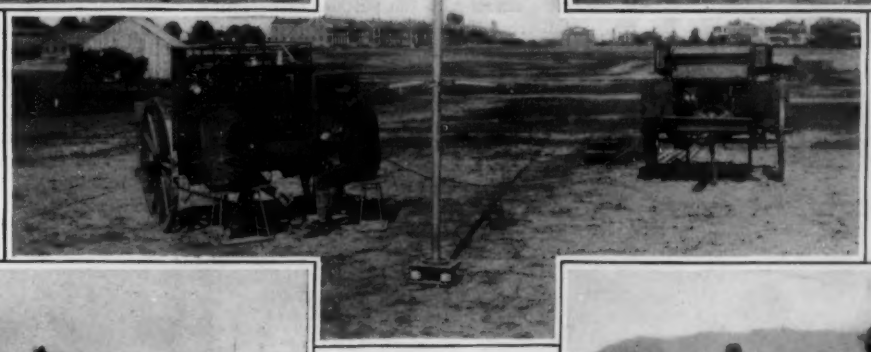
An entirely new and absorbingly interesting field of work has been opened up for the Signal Corps in aviation. The Signal Corps has long been charged with the balloon work of the Army, and quite recently an act of Congress has been approved which adds to the Signal Corps an aviation section of two hundred and sixty men. Sixty officers may be detailed in this aviation section from the line of the Army. It is to be hoped that the impetus this favorable legislation will give military aviation may awaken interest and secure a vast expansion which this highly important new aid to the art of war deserves.

The United States secured, through the specifications put out by the Signal Corps in 1907, the first military aeroplane in the world. The biplane turned over by the Wright Brothers in 1909, after the final cross-coun-

(Concluded on page 192.)

Field buzzer station receiving message over field wire laid from reel cart. The field buzzer was invented to operate over leaky wires of high resistance, such as are paid out on the field of battle from a hand reel. The instrument can also be used as a field telephone.

A radio pack section, repacking the outfit, preparatory to an advance. These light packs have been devised to accompany swiftly moving cavalry. It would be inadvisable to hamper divisional cavalry's movements with wire connections of any kind. Hence, the radio pack's reason for existence.



Operating and generating parts of a 2-kilowatt wagon radio set. Note 80-foot mast. This apparatus is carried in a special type of pintle wagon and is always ready to set up and communicate with the cavalry and other pack sets.

Field-wire section laying line from reel cart. Note portable telegraph poles.

Radio pack section. Packs removed. Sectional 40-foot mast is being erected.

From Fighting Line to Hospital

Surgery, Medicine and Organization Mitigate the Horrors of War

Hoisting wounded into a German ambulance.

German stretcher bearers bringing in a wounded soldier.

MILITARY sanitation, the service devoted to keeping the soldier in health, has received little attention from the general public. It is closely related to the health problems of civil communities. Military conditions have afforded opportunities for striking demonstrations of the possibility of controlling yellow fever, malarial fever, and typhoid fever, so that there is good ground to hope that in the future armies need not be decimated by disease.

The plans and organization of the strictly medical service of armies, which cares for the sick and wounded, are seldom discussed. The public in general are content to dismiss the subject with some general statement to the effect that sick and wounded soldiers, especially in war, should have every comfort which money can buy; that nothing is too good for those citizens who risk their lives in its defense. The sentiment which prompts such a statement is most commendable; the manner in which it is put in practice may well be most thoughtfully considered, in order that in case of war there may be intelligent co-operation between the Medical Department of the Army and the great body of the people who are anxious to render assistance. There must be a complete and definite understanding as to what is to be accomplished, the means available for its accomplishment, and the limitations under which the work must be conducted. The latter consideration is of prime importance, for it must be constantly borne in mind that the medical service is at best but a minor accessory to a great machine, the purpose of which is to win battles.

The most elementary study of the subject suffices to show us that any army which attempted to maintain with its troops at the front a medical service sufficient to render immediate aid to all the wounded in a great battle would be submerged by the personnel and equipment required. Aggressive action would be a physical impossibility. Our greatest military authorities tell us —and history confirms the statement—that victory is won by the army which has learned to campaign with a minimum of baggage, which can move rapidly, and concentrate its strength quickly on the enemy's weak point and deliver the decisive blow before the enemy has an opportunity to reinforce the vulnerable spot. The army which is rendered cumbersome by the abundance of its supplies and which dissipates its energies in guarding its wagon trains is an easy prey for a mobile opponent.

The old hunter can be identified by the meagerness of his kit. He has learned by experience how few articles are worth their weight and the room they require in the field.

Volunteer soldiers, individually and collectively as armies, are particularly prone to burden themselves with equipment of all kinds, most of which they later discard as worthless impedimenta.

Assuming, then, that supplies of all kinds are abundant and that the matter of economy does not enter into the consideration, would it eventually prove a kindness to equip an army for campaign with everything necessary to supply its men so far as possible with the comforts to which they are accustomed at home, or, on the other hand, is it true that war, from its very nature, requires a temporary reversion to those more primitive conditions in which the needs of the individual are few and simple? The latter assumption is accepted by the medical department as the basis for constructing its scheme of service with the troops on the firing line. A thorough understanding of this basis and the necessity for its adoption is essential to an intelligent discussion of the plans for caring for the sick and wounded.

From the standpoint of military efficiency, the ideal army would be one in which every man carried a rifle, and unhampered by personal equipment was able to devote his entire energies to the purpose of defeating the enemy; similarly, the ideal medical service for such an army would be one which, without encumbering the fighting forces with supplies, equipment, and non-combatant personnel, would appear on the battlefield at the desired moment, render first aid to the wounded and whisk them away in fairy-like manner, out of the zone of combat, to a place where all the comforts of civilization and all facilities for their treatment and the best medical and surgical skill obtainable are at hand.

Absolute realization of these ideals, either for an army or for a medical service, is, of course, unattainable. An army must have a supply service, a telegraph service, and a medical service, operated by men who do not carry rifles and who are unavoidably an impediment; but their presence is justified by the purely military advantages which the army gains by their services. Thus, it is universally conceded that the *morale* of troops is improved by the knowledge that they have with them even a very limited number of medical attendants. Every military leader desires, of course, to provide his men with every comfort which it is practicable for them to have without impairing to an unwarranted degree the fighting power of his army, and each desires the most efficient medical service it is possible to obtain with a limited allowance of personnel and equipment.

The general system adopted for providing a medical service is practically identical in the armies of all the great powers. It contemplates a division of the service into three portions: that which belongs to and accompanies the fighting troops; that which pertains to the base (of supplies) and the line of communications; and that which pertains to the home territory or "the zone of the interior." The principle governing these services is that nothing but first aid and emergency treatment should be attempted in the immediate zone of combat, and that having received this treatment, the disabled should be quickly transported to the "base," where abundant facilities for their care can be provided without encumbering the fighting forces. Here at the base they are carefully classified and those who are so seri-

Red Cross nurses at the army kitchen.

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German medical corps in the field.

ously disabled as to be unfit for further service at the front are sent back to hospitals at home, while those who are less seriously disabled are retained until they are well enough to leave the hospital, when they are transferred to the Convalescent Camp. Here they remain until they have fully regained their strength, when they rejoin their regiments at the front.

The accompanying diagram shows schematically three brigades of infantry in line, with some artillery between them and slightly in the rear, and some cavalry on either flank. These troops, with their engineer, signal corps, and sanitary troops attached, constitute a Division, which is the great tactical unit of our army, so equipped that acting independently it is an effective unit. The sanitary troops of the division are of two classes, those which pertain to the regiments and accompany them into battle or wherever they go, called "regimental detachments," and those which remain slightly in the rear, under the command of the Division Surgeon, called the Field Hospitals, Ambulance Companies, and the Reserve Medical Supply. Each Ambulance Company is equipped to establish one Dressing Station, which is usually located as near the firing line as it is practicable to take the ambulances. The Field Hospitals are located three miles or more behind the firing line, well out of the range of fire, and usually where suitable buildings can be utilized, though each field hospital equipment includes tentage which can be used when needed. The ambulances of the division then ply between the dressing station and the field hospital. In advance of the dressing stations are seen the regimental aid stations, one established by each regiment. The ambulance company operates not only the ambulances but a detachment of thirty or more litter bearers who bring back the wounded from the regimental aid stations to the dressing stations. Each regiment of infantry is allotted four surgeons and twenty-four enlisted men of the hospital corps, and before a battle the band, probably aggregating about twenty men, is ordered to report to the senior surgeon, to act as litter bearers. About fifty-four men are thus provided for duty as litter bearers and to render first aid. Of these, four are non-commissioned officers, who take charge of the several groups into which the men are divided; four are assistants to the four surgeons, and about four additional remain with one of the surgeons at the dressing station. There are thus left about forty-two men, or twenty-one litter squads, to bring the wounded back to the regimental aid station. This is about one litter to every seventy-five men on the firing line; losses for individual regiments may be estimated at from 5 per cent to 30 per cent.

The three surgeons, in addition to the one in charge of the regimental aid station, are assigned one to each of the three battalions of the regiment—one surgeon to about five hundred men.

These proportions are not greatly different from those allowed in European armies, considering differences in organization. France and Germany each allow six medical officers to a regiment, Italy seven, and Austria-Hungary five; but their regiments are usually about three thousand strong, while ours are about eighteen hundred strong.

The lines of medical service on the battlefield, within the Division, have been outlined. The work at each station may possibly be best described by tracing the course of wounded men from the front to rear. Privates A and B, both of Company D, Ninth Regiment of Infantry, Third Brigade, are wounded, the former shot through the left hand and the latter through the right leg, fracturing one bone. Private A's wound is slight. He detaches the first aid packet which every soldier carries suspended from his belt, opens it, and applies one of the two bandages it contains to his wounded hand and finds the surgeon, tells him what he has done, and is given a diagnosis tag bearing his name and marked "To Station for Slightly Wounded" and signed by the surgeon. This tag serves as a pass to allow this man to go to the rear. He is perfectly able to walk, and he proceeds to the Station for Slightly Wounded, where he finds a doctor and some Hospital Corps men who have been detached from one of the Field Hospitals to establish and operate this station. Here his wound is carefully dressed and he lies down under the trees to wait the end of the engagement, when he joins his regiment. The purpose of the Station for Slightly Wounded is to prevent this class of cases from going to the Dressing Stations and Field Hospitals, which will be congested with the seriously wounded.

A surgeon finds Private B, discovers the broken bone and applies a dressing and a splint, and turns him over to a litter squad to be carried to the Regimental Aid Station, having first tied a diagnosis tag to his blouse. On arrival at the Aid Station, located in the dry bed of a stream, the banks of which are high enough to afford protection from bullets, he is placed under the shade of a tent fly and given a cup of bouillon; the dressing on his leg is inspected and found in good condition. While waiting at this station he sees numerous wounds dressed, light nourishment being prepared and served, and several Hospital Corps men come in to the Station to replenish their stock of dressings. Presently bearers arrive, and he is placed on a litter and taken to the Dressing Station. He enters the Receiving Station, is examined by a surgeon, and assigned to the Slightly Wounded Section, as he requires no further treatment at this time.

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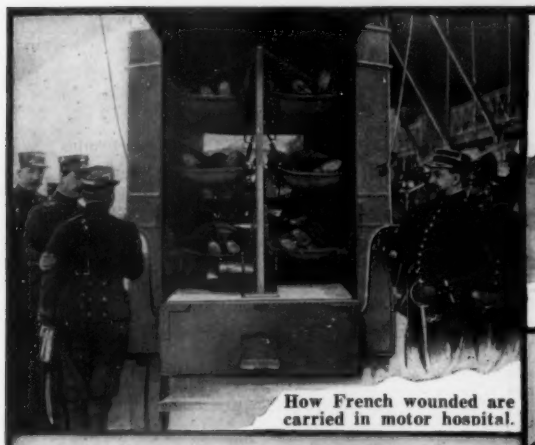
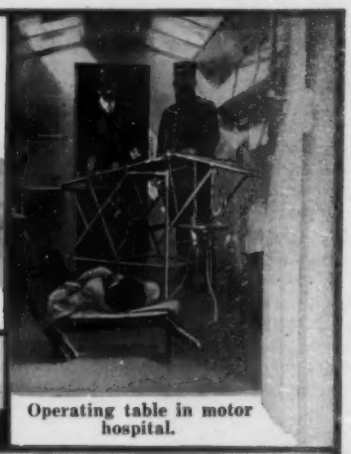


How French wounded are carried in motor hospital.

The latest French motor hospital.



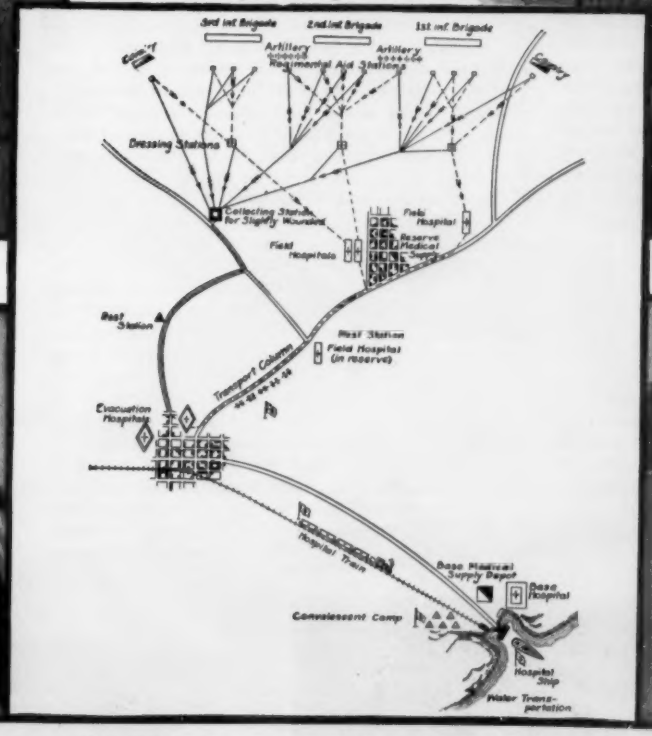
Operating table in motor hospital.

Equipment of a regimental aid station.

French motor hospital set up in field.

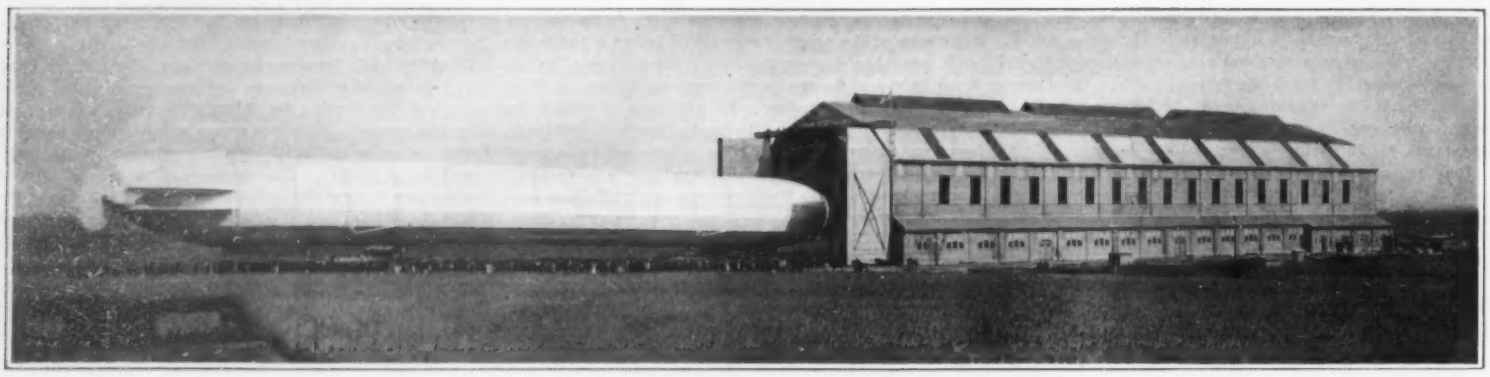
Unloading a Servian hospital train.

Operation tent, field hospital. Acetylene light used.



Map showing lines for return of wounded from field.

Man shot through foot carried by one bearer.



A Zeppelin rigid dirigible leaving the great airship shed at Baden.

Aircraft in War

How Aircraft Will Affect Strategy; the Air Strength of Europe

ALL eyes are turned upward in the present war. For the first time in history the air will play its part in a great campaign. Within the brief space of ten years air fleets have been built by the great military powers to meet just such a contingency as that with which they are now confronted.

Hardly had the flying machine and the dirigible been made half-way practicable, when we were told that henceforth battleships, great armies, and fortifications would be useless. Military experts knew better. A flying machine or a dirigible is a new kind of fighting machine, which will merely be added to the old machines.

For centuries the main principles of war have been unchanged. The fundamental difficulties of a campaign are much the same now as when Rome wiped out Carthage and Cæsar conquered Gaul. Even aeronautics will not alter them. Seven centuries ago armies of 30,000 men clubbed, speared, piked, and hacked each other a few yards apart. At Waterloo there were 120,000 men on one side and 90,000 on the other; cannon and muskets separated the opposing forces half a mile and more. In the battle of Mukden, fought in 1904 by the Japanese and Russians, 650,000 men were engaged; the battlefront was about one hundred miles long; high-power artillery with a range of miles kept the hostile forces so far apart that most of the Japanese and Russians never saw each other. So, the dirigible and the aeroplane are new engines of war. As such they will modify the manner in which the old principles are applied. The principles themselves will not be changed.

What Will Be the Effect of Aerial Reconnaissance?

No one can tell exactly how efficient aircraft will be in the present war. But it is certain that battles must be more carefully planned. The cavalry raids which marked our Civil War, the hidden movements of a mobile force, so well handled that it could even defeat larger numbers, will be quite impossible, simply because they will be detected by the airscout. Modern armies are so huge that they cannot easily be rearranged after their "strategical deployment," as it is called, has once been decided upon. Hence the use of aircraft will develop farsightedness in the preliminary disposition of troops and bring about a general speeding up of strategic operations. Because of the eye in the air, opposing army corps will become more like naval squadrons; their presence and strength will be revealed to each other, as the presence and strength of battleship fleets are revealed at sea. With positions, strengths, and movements known, it is evident that a new strategy must be developed. Great mobility and great numbers will count for more than ever before.

With cards thus of necessity all laid on the table, we may expect more merciful preliminaries than in the past. Before the days of the airship and aeroplane a general had to feel the enemy's strength. He sent out skirmishers and cavalry, whose losses were the only test he had of the strength and position of his foe. Even then he might be fooled by feints, by masked movements. At Mukden the Japanese caused the Russians to think that the Russian right flank would be turned. Reserves were hurried east to counteract the expected movement. Countermarching westward, they could be thrown only piecemeal against the true Japanese flank attack. The result can be imagined. Suppose that the Russians had commanded the air. Suppose that they had discovered the actual movements of the Japanese reserves and met flank attack with outflanking movement. What a different battle it would have been!

Waiting for the Air Scouts' Reports.

Because he has aircraft at his disposal a modern general will be more apt to await the results of their reconnoitering before giving final orders. In other words, there ought to be fewer counter orders in present European engagements than during the Franco-Prussian War. There is too big a risk of moving troops in the wrong direction. It is estimated that within 3½ hours a general may expect an air report of his foe's strength, position, and movements if he is within a radius of 80 miles. If cavalry alone were used for the same purpose probably three days would be required, and the information collected would not be so precise. Three and one half hours is not too long to wait before giving a definite order, which may result in victory or defeat.

Reconnaissance is of two kinds—strategical and tactical. By strategical reconnaissance we mean the observation of main bodies, in column of route, for example. In tactical reconnaissance troops must be observed after they have left the roads—a difficult task because the troops are harder to find, and it is not easy to estimate their strength. It is evident that there will be more tactical than strategical reconnaissance as the strategical merges into the tactical phase. Hence, the greater number of flights as armies engage will be short flights for tactical reconnaissance which will result in placing information immediately in the hands of a commander.

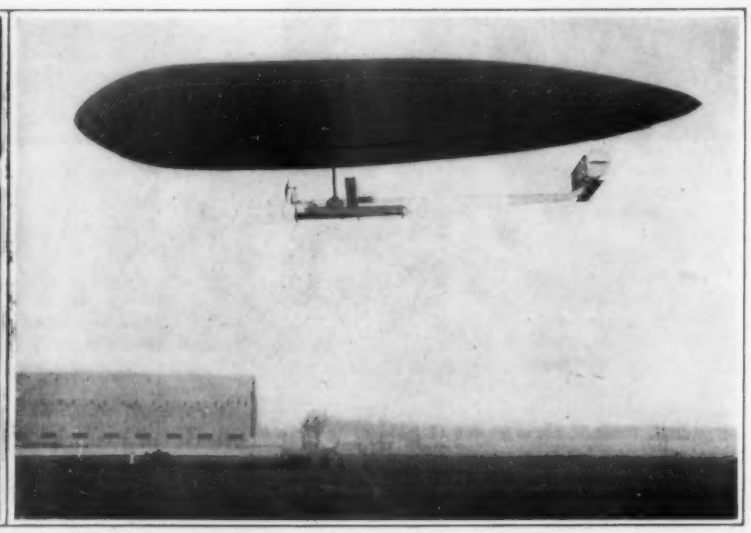
Will There Be Battles in the Air?

Since all the great powers now engaged in war have aeroplanes and dirigibles, battles will not be aeronautically one-sided. Both dirigibles and aeroplanes of some types carry guns. Some attempt will be made to fight off an airscout. How serious the attempt will be no one knows. The personal risk of an encounter is so very great that it may be questioned if it will be lightly taken. Fighting with a rifle or machine gun at an elevation of a mile is obviously perilous. A clipped control cable, a fractured wing spells death. Is our twentieth century courage equal to such a fight in the air?

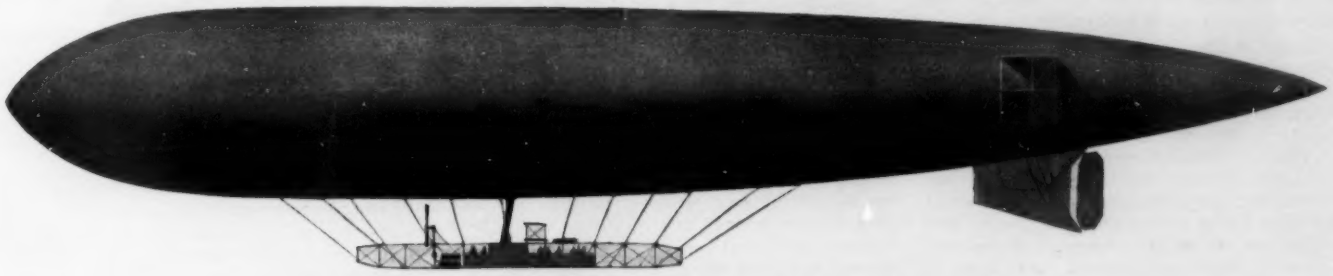
Bomb-dropping, too, is to be tried out on a large scale. How destructive large quantities of explosives dropped from dirigibles can be no one really knows. The censors have not allowed the press of the world to state whether or not explosives were dropped on the fortifications of Liège. If they were—and it seems likely that some effort in that direction may have been made—the destructive effect could not have been great in view of the forts' stubborn resistance.

After all is said, the aircraft of the warring powers are more likely to be used for reconnaissance than for any other purpose. To reconnoiter speed is necessary for less obvious purposes than the covering of great distances in a short time or escaping an attack. In a high wind only the high-powered flying machine can be used at all. That was conclusively proved in the last Army Exercises of Great Britain. The weather was continuously bad. Low-lying clouds rendered observation impossible from a height exceeding 2,500 feet (dangerously low because of the chance of being hit from below), while high and gusty winds prevailed. Some of the aeroplanes used were biplanes of a relatively slow type, with a maximum speed of 55 miles an hour. When the wind attained a velocity of 50 miles an hour, the slow biplanes were unable to accomplish any effective work. True, they ascended; but their speed, being insufficient to allow them to make any headway against the wind, they were unable to attain the enemy's lines, which were distant only a few miles. On the other hand, the swifter machines were never

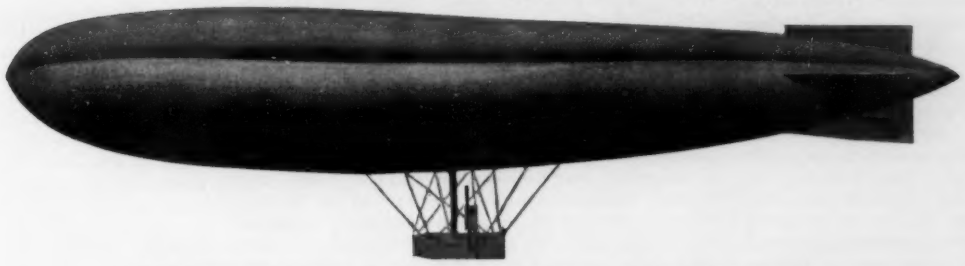
Car of a Clément-Bayard airship of a type which is still in commission, but which has been greatly modified.



The Clément-Bayard V, which once held the altitude record for dirigibles (2,900 meters). The type is not unlike the German Parseval.



France must be credited with at least eighteen airships of various types.

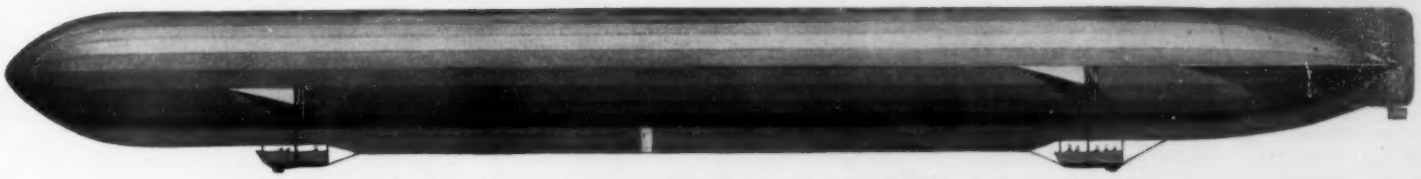


If England's programme can be carried out by the end of the year she ought to have fifteen dirigibles in service. As it is she can rely on only seven.

Russia has probably not more than three airships available.

Belgium has one airship.

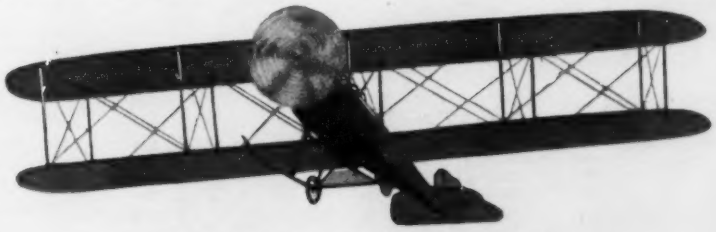
Austria has not less than three nor more than five airships available.



Germany can put into the air twenty-three airships of the rigid, semi-rigid, and non-rigid type.

The French Army has at least 500 aeroplanes at its disposal in the present war.

Austria has at least 50 aeroplanes.



England has about 250 aeroplanes of all types.

Russia has 50 aeroplanes.

Germany is about the equal of France in aeroplane strength. She has 500 flyers.

THE AIR STRENGTH OF EACH NATION IS SUPPOSED TO BE CONCENTRATED FOR PURPOSES OF GRAPHIC COMPARISON IN ONE HUGE DIRIGIBLE AND ONE HUGE AEROPLANE

idle. They flew day after day, regardless of wind and weather. The lesson is obvious: Slow machines are worthless for all conditions of field service.

Speed is the Governing Factor.

There was a time when aeroplane speed was subordinated to durability and strength. But in those days (three years ago) aeroplane accidents were more frequent than they are now. It was thought then that biplanes would be employed exclusively for military purposes because of their stauncher construction. Indeed, there was even an understanding if not an actual rule in the War Offices of the European Powers that biplanes were to be ordered in preference to monoplanes, All that seems to have been changed. Both types of machines are to be found in use. Monoplanes are stanch enough to withstand extraordinary strains, as the looping performances of Pégoud and his imitators have abundantly proved. The main consideration is that of speed; slow machines cannot be used nowadays, in other words, machines that travel at speeds of less than fifty miles an hour. The policy of the French army is a good case in point. Between 1912 and 1913 orders for the faster Henry Farmans increased by 300 per cent, while those for the slower Maurice Farmans decreased by over 30 per cent. As soon as Maurice Farman increased the speed of his machine by relegating the elevator to the tail and making other improvements it was restored to army favor. The armored machine, too, is much sought after. In 1912, for example, only eight Voisins were ordered. As soon as Voisin produced his steel, 70-mile an hour machine, an order for thirty-one was promptly placed.

The Rôle of the Airship.

While the aeroplane has proved its utility both in the Morocco and Balkan campaigns, the dirigible is still a military enigma. The operations of European armies during their annual maneuvers are shrouded in a veil of secrecy as dense as if the forces were engaged in real war. Germans and Frenchmen shrink from publishing the results of their military experiments for each other's benefit. Great Britain is less secretive. Her last Army Exercises, which were fully reported and analyzed in the London press by competent military men, demonstrated conclusively that the slow, non-rigid dirigible is certain to be destroyed should it attempt to take part in daylight warfare. Speed alone can save it; but speed imposes prohibitive size and power for that type of craft. The lesson is clearly taught by the evolution of the rigid type. The Zeppelin built in 1906 had a volume of 430,000 cubic feet; that of 1911, 627,000 cubic feet; the first naval craft wrecked off Heligoland, 776,000 cubic feet; and the second naval Zeppelin, "L 2," 950,000 cubic feet. Still larger vessels are in course of construction. Speed has increased correspondingly from 36 miles an hour in 1906, to 52 miles an hour in 1912, and over 60 miles an hour in 1913. The very latest type has an average speed of about 65 miles an hour, and has made as much as 94 miles with the wind. In other words, the latest Zeppelins compare favorably in speed with the fastest army aeroplanes. The vast radius of action of the Zeppelins, both new and old, enables them to work from bases far from the scene of operations. Recognizing that fact, and evidently planning to use Zeppelins in that way, Germany has constructed a large number of "airship harbors," with sheds mounted on turntables. France has similar harbors, less elaborately equipped, but without turning sheds.

The Zeppelin and Its Possibilities.

From the practice which the crews of Zeppelins have had in handling guns and bombs while in the air, it is evident that Germany intends to use her Zeppelins as real fighting battleships of the air. That the machine guns may prove serviceable in beating off attacks from aeroplanes is generally conceded; but on the effect of high explosives dropped overboard by the hundred-weight, opinion is divided. While the moral effect must be huge, it is contended that the actual damage that can be inflicted must be small. If it is true that explosives were dropped from Zeppelins in the heart of Antwerp, the actual loss of life that resulted and the damage done were not as great as might be expected. It is reasonable to suppose that trials have been made with dropped explosives before committing the Zeppelins to this new method of attack. The fact that a dirigible can hover stationary over a given spot simplifies the problem of hitting the target from a height of a mile and a half.

While we hear much of the terrible bomb-dropping possibilities of airships, both rigid and non-rigid, we are apt to overlook one enormous strategic advantage of the airship over the aeroplane, and that is its ability to travel safely and surely at night. As yet we have learned nothing of the nocturnal activities of dirigibles; the Zeppelin attack on Antwerp is said to have occurred after dusk; but when the war is over or when the veil of mystery is lifted a little we may hear of airships that set out after dark, traveled with muffled motors over a fortified position, swooped down suddenly to determine the strength of a position, and rose quickly before a damaging fire could be opened. Searchlights must be used in such exploits—searchlights which, while they betray the dirigible's presence, also momentarily dazzle the riflemen.

That the rigid type of dirigible is far inferior to the non-rigid, the experiences of the last British Army Exercises showed. Two non-rigid airships were employed, both well handed. But they were slower than the slowest aeroplane, which would have meant certain destruction from machine-gun fire in time of war. Moreover, they could not ascend to any great height. On days when the wind was high they were useless, and even when the wind had dropped, hostile aeroplanes made it a point to circle around and above them. How long these non-rigid dirigibles would last in war if opposed by fast, armed aeroplanes, can be imagined. On the other hand, a Zeppelin would have a chance of escape, not only because it is armed, but because of its ascensional speed. The passenger Zeppelin "Viktoria Luise" can rise 3,500 feet in 5 minutes, and the newer military Zeppelins still faster. Since the ascensional speed of an aeroplane is about one half that of the "Viktoria Luise" a Zeppelin ought to be able to seek refuge in the upper reaches of the air when it is hard pressed. The loss in gas, however, must be reckoned with.

The Air Strength of the Powers.

Germany's aerial fleet is better organized, better designed, and better equipped than that of any other European power. Her Zeppelins must be regarded as the most formidable aircraft thus far devised. But besides the Zeppelins she also has airships of other types which can hardly be considered any more effective for daylight use than the three British dirigibles which gave so poor an account of themselves in the last

(Concluded on page 192.)

GERMAN NAVAL AIRSHIPS (RIGID TYPE).

Name.	Make.	Date.	Displacement in tons.	Length in feet.	Diameter in feet.	Speed in miles per hour.	Total horse-power.
L 5 (?)	Zeppelin	1914	32.0	550	61	62	1,100
L 4	Schütte-Lanz	1914	30.0	550	61	50	1,030
L 3	Zeppelin	1914	32.0	550	61	50	720

GERMAN ARMY AIRSHIPS (RIGID TYPE).

Z 8	Zeppelin	1914	22.0	515	49	48	540
Z 7	Zeppelin	1913	22.0	515	49	43	540
Z 6	Zeppelin	1913	19.5	465	49	43	540
Z 5	Zeppelin	1913	19.5	465	49	43	540
L 4	Zeppelin	1913	19.5	465	49	43	540
Z 1	Zeppelin	1913	19.5	465	49	48	540
Z 3	Zeppelin	1912	17.5	462	46	49	450
Z 2	Zeppelin	1911	17.8	485	46	48	450
S.-L.1	Schütte-Lanz	1909-(1912)	19.0	430	60	46	540
S.-L.2	Schütte-Lanz	1914	23.0	475	61	50	720

GERMAN PASSENGER AIRSHIPS (RIGID TYPE) AVAILABLE FOR WAR.

Sachsen	Zeppelin	1913	19.5	465	49	48	540
Hansa	Zeppelin	1912	18.7	485	46	50	540
Viktoria Luise	Zeppelin	1912	18.7	485	46	48	450

GERMAN SEMI-RIGID AND NON-RIGID AIRSHIPS (ARMY).

The P airships are non-rigid and the M airships semi-rigid in the following table.

Name.	Make.	Date.	Displacement in tons.	Length in feet.	Diameter in feet.	Speed in miles per hour.	Total horse-power.
P 4	Parseval	1914	11	280	50	47	360
P 3	Parseval	1911	10	280	52	40	400
P 2 (Ersatz)	Parseval	1910	8	254	49	32	360
M 4	Gross	1913	13	320	44.5	47	450
M 1	Gross	1912	6	245	36.3	28	150

OTHER GERMAN AIRSHIPS AVAILABLE.

Vesh I	Deutsche Luftsch-Werft	1913	5	220	45	43	260
P L 6 (Stollwerck)	Luftfahrzeug G. m. b. h.	1910	4½	250	45	38	220

The Theater of the Present Franco-German Struggle

A STUDY of the adjoining map of the theater in which the most important battles, at least of the opening phases of the War of the Nations, are now being fought, shows why it was that Germany broke faith with Europe and ruthlessly entered the fair lands of unoffending Belgium, carrying with her fire and the sword!

In the first place, the most direct advance on Paris (the German objective) can be made across Belgium by way of the valley of the Meuse. The border line between Germany and Belgium is only about 175 miles from Paris, and from the Belgian frontier to Paris is about 135 miles. Through that portion of the valley of the Meuse which lies in Belgium runs one of the main railroad lines leading from the great industrial center in which lies the Krupp works, direct through northeastern France to Paris.

Of the French frontier between the North Sea and Switzerland, only one half is conterminous with that of Germany. The strategy of the German army, in the event of a conflict with both France and Russia, contemplated a concentration of the flower of the German army against the French lines of defense so swift, and in such superior force as to make sure of striking a crushing blow at the very outset of hostilities. Meanwhile Russia was to be opposed by the reserves, which, if at first outnumbered, would have the Vistula and its strong defenses to fall back upon and hold until sufficient reinforcements arrived for the eastern German armies to take the offensive.

Now, because of the treaty guaranteeing the neutrality of Belgium, to which Germany was a signatory, the French, after the disasters of 1870, concerned themselves mainly with the defense of the southerly half of their frontier, facing the forfeited provinces of Alsace and Lorraine; and they built a chain of entrenched camps, city fortifications, and interconnecting forts, which presents a practically unbroken front from Verdun in the north, opposite the Duchy of Luxemburg, to the far-famed fortified town of Belfort on the Swiss frontier. The Franco-German frontier is about 120 miles in length, and facing the border, from north to south, are the heavily fortified cities of Verdun, Toul, Epinal, and Belfort, each of which bestrides one of the most important railroads and highways leading from Germany to French soil. These cities divide the border into three equal lengths, each of about 40 miles.

The defenses of these cities are approximately similar, consisting of an outer circle of forts, spaced 2½ miles apart from each other, with a circumference of about 50 miles; back of which is an inner line of defenses and a citadel. Between the Swiss frontier and Belfort is a chain of forts, so spaced that the intervals are swept by gunfire, and a similar chain connects Belfort and Epinal, and Toul and Verdun.

The new scheme of defenses did not include the Belgian frontier, the French believing that Germany's signature to the treaty guaranteeing the kingdom's neutrality was a sure enough defense. Along that border are only the original frontier forts, Longwy and Montmedy, and the great entrenched camp, Maubeuge.

Back of this first line of forts and fortified cities, which may be considered practically impregnable to direct assault, is a second line, behind the shelter of which, should the first line be forced, the shaken armies of France could reform, and be strengthened by reserves and recruits.

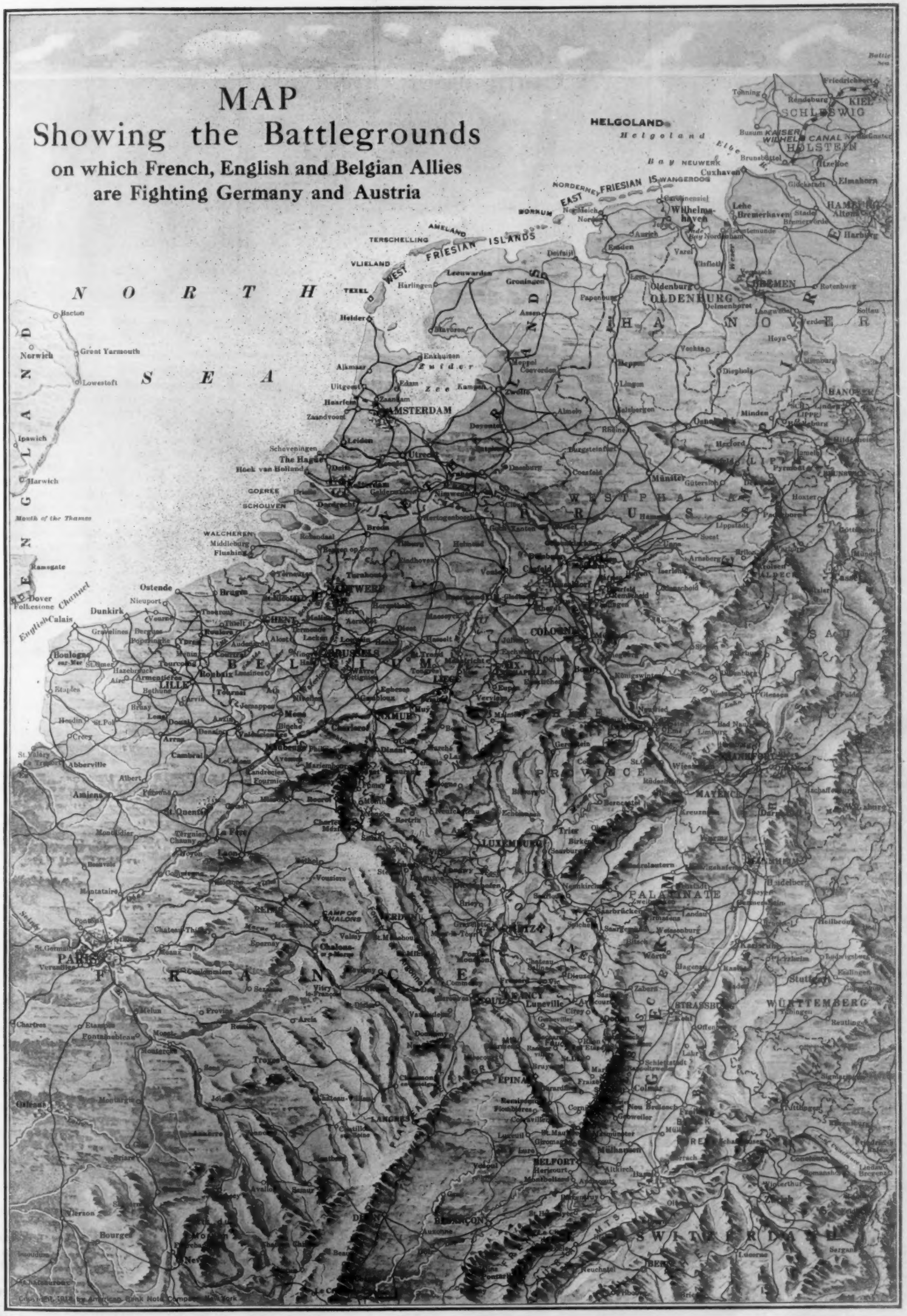
In the south, back of Belfort, and some 50 miles distant therefrom, is a triangle of three strongly fortified cities, Besançon, Dijon, and Langres, the sides of the triangle being approximately 50 miles. These cover the railroad from South Germany to Paris, *via* Belfort, just as Toul covers the road from Strasburg to Paris, and Verdun opposes a German advance by way of the railroad from Metz.

Some 60 miles back from the Belgian border is another line of defensive works, consisting of the fortified cities of Rheims and La Fue and an inter-connecting line of forts.

Should the German invasion break through the frontier and the intermediate barriers, there remain the two great circles of forts that surround the city of Paris. The outer ring, constructed since 1870, consists of an unbroken circle of forts and batteries measuring over 70 miles in circumference. It is built 7 miles beyond the city limits; and three miles nearer the city is the ring of famous forts that figured in the siege of Paris 1870-71. It would take an army of 600,000 men effectively to besiege modern Paris. Can Germany batter her way across France, and reduce Paris? The answer lies with the German infantryman.

In a patent, 1,104,802, Robert C. Hub of Detroit, Mich., combines a mud-guard and air-deflector with a radiator hood so that the guard and deflector operate to insure a positive circulation of air through the radiator.

MAP
Showing the Battlegrounds
on which French, English and Belgian Allies are Fighting Germany and Austria


HELGOLAND
Helgoland
Bay
NEUWERK
Cuxhaven
NORDERNEY
FRIESIAN IS.
WANGEROOG
EAST
BORKUM
AMELAND
TERSCHELLING
FRIESIAN ISLANDS
VLIELAND
WEST
TEXEL
Helder
NORTH SEA
Harwich
Ipswich
Norwich
Great Yarmouth
Lowestoft
Mouth of the Thames
Ramsgate
Dover
Folkestone
English Channel
Calais
Boulogne
Ostende
Nieuport
Dunkirk
Bruges
Middleburg
Flushing
WALCHEREN
SCHOUVEN
GOEREE
Scheveningen
The Hague
Hoek van Holland
Leiden
Haarlem
Hearfeit
Zaandvoort
AMSTERDAM
Zuider Zee
Kampen
Zwolle
Meppel
Coevorden
Assen
Groningen
Leeuwarden
Harlingen
Delfzijl
Emden
Aurich
Varel
Oldenburg
Papenburg
Leer
Elsfleth
Bremen
Rotenburg
Harburg
Cuxhaven
Brunsbüttel
Itzehoe
Elmshorn
Glückstadt
Lehe
Bremerhaven
Wilhelmshaven
KIEL
SCHLESWIG
HOLSTEIN
KAISER WILHELM CANAL
Friedrichsort
Rendsburg
Tönning
Husum
HANOVER
OLDENBURG
Diepholz
Verden
Hoya
Nienburg
Minden
Osnabrück
Bentheim
Rheine
Almelo
Enkhuizen
Edam
Uitgeest
Alkmaar
Beppen
Lingen
Coesfeld
Münster
Hamm
Hexford
Detmold
Lippstadt
Soest
Arnsberg
Iserlohn
Brilon
Paderborn
Höxter
Pyrmont
Hildesheim
Göttingen
Münden
Cassel
WESTPHALIA
PRUSSIA
Rotterdam
Delft
Dordrecht
Gorkum
Nijmwegen
Cleve
Xanten
Duisburg
Ruhrort
Crefeld
Düsseldorf
Elberfeld
Remscheid
Solingen
Barmen
Essen
Mülheim
Oberhausen
Recklinghausen
Dorsten
Wesel
Emmerich
Arnhem
Zutphen
Deventer

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Sir J. R. Jellicoe, in supreme command of the British fleet.

A Comparison of Naval Strength

Overwhelming Superiority in Ships and Guns Possessed by the Triple Entente

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High Admiral Alfred P. T. von Tirpitz, commander of German navy.

[It is not our purpose in the present article, dealing with the relative strength of the fleets of the Triple Entente and the Dual Alliance, to enter into the question of how far such a comparison is affected by the geographical situation. This will be done in the successive articles dealing, seriatim, with the various navies that have been drawn into the general European war. In passing, however, we may mention that the complete separation of the German and Austrian fleets, the former having retired to the Baltic and the latter to the northern end of the Adriatic, greatly weakens the naval situation, so far as the Dual Alliance is concerned; whereas the interposition of the combined British and French fleets, between the widely separated forces of the enemy, enables them to deal with the German and Austrian fleets in detail and to concentrate their own forces in overwhelming superiority for united action.—EDITOR.]

THE relative strength of the contending navies is told, graphically, in the adjoining illustrations and, in detail, in the table given below. With regard to the drawings it should be carefully explained that they are based upon the total tonnage displacement of the fleets engaged. This is the fairest basis of comparison; for the naval architects of the world are so well acquainted with the work of their competitors, that it is safe to say that a ton of displacement has a certain definite military value, which renders it an accurate unit for comparisons such as those shown upon the accompanying page. As between two ships of similar displacement the distribution of the weight may vary and does vary very considerably. One ship may carry more guns at the expense of armor; the other may make a larger allotment of weight to the motive power, preferring the tactical advantage of high speed to that of more guns or heavier armor. Of course, some serious mistakes have been made in the design of important ships in various navies in the world, as we shall show in a later article; but, speaking broadly, it may be said that the development of the warship in the various classes: dreadnoughts, pre-dreadnoughts, armored cruisers, protected cruisers, etc., has proceeded along certain well-defined lines, and, especially in the work of the last ten or fifteen years, there have been but few mistakes of a glaring character.

Referring again to the illustrations, it should be carefully noted that the various ships are to be compared as to length only, and that no account should be taken of the bulk of the ships compared. Thus, in the diagram representing the dreadnought strength it will be seen that the larger ship, corresponding to the fleet of the Triple Entente, is twice as long as the lower ship representing the dreadnoughts of the Dual Alliance.

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The Kaiser, in supreme command of Germany's navy.

Attention is drawn to the fact that there is a discrepancy between the total displacement figures shown in the drawings and those given in the table. This is explained by the fact that the table, drawn up as we go to press, gives the very latest figures obtainable. We have learned on reliable authority that Great Britain, since the declaration of war, has taken over the two powerful dreadnoughts which were completing in British yards for the Turkish government. These vessels are the "Osman I" of 27,500 tons, carrying fourteen 12-inch guns, and the "Reshadieh" of 23,000 tons, carrying ten 13.5-inch guns. This adds 50,000 tons to the total displacement of the British navy. Again, since the war opened, Germany has lost one of her latest dreadnoughts, the battle-cruiser "Goeben" of 23,000 tons, carrying twelve 11-inch guns, and her displacement is reduced accordingly.

It should be noted that this comparison takes no account whatever of ships that are not yet completed. All the great powers have under construction several dreadnoughts in a more or less advanced stage of construction, and many of them require only two or three months' work to put them in commission. Thus Great Britain has two ships of the "Queen Elizabeth" class which will be completed in six weeks' time, and two others are to be ready by the end of January next year. These are 25-knot dreadnoughts carrying each eight 15-inch guns, and they will be the only ships afloat carrying a gun of this power. Germany by October will have completed three dreadnoughts of the "Koenig" class, carrying ten 12-inch guns. France should complete this year two dreadnoughts of the "Bretagne" class, mounting ten 13.5-inch guns, and Russia should put into commission two dreadnoughts of the "Gangut" class, carrying each twelve 12-inch guns. None of these ships, however, are available in the opening phases of the war, and they will not be in line for the first shock of conflict.

At the opening of the war, then, we find that the Triple Entente has 35 dreadnoughts against 19 for the Dual Alliance—a crushing superiority, were it not for the existence of the Kiel Canal and the strong defensive position afforded by the Baltic, where the German fleet has probably taken refuge. In pre-dreadnoughts the Triple Entente has 66 ships as against 26 for the Dual Alliance. In armored cruisers, 60 to 11; in protected cruisers and scouts, 92 to 46. There is

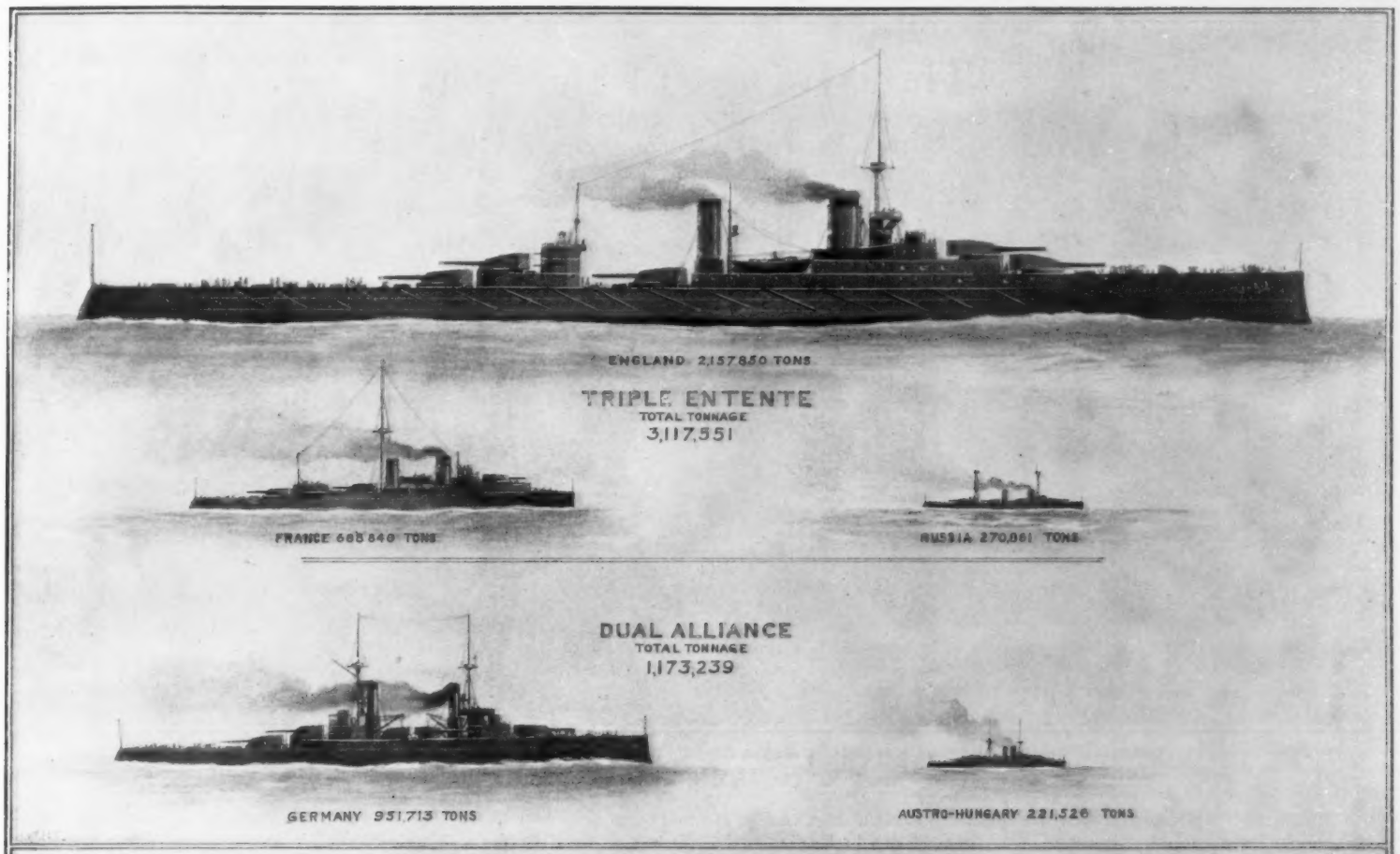
(Concluded on page 198.)

COMPLETED SHIPS OF THE CONTENDING NAVIES, AUGUST 1st, 1914.
Including warships of 1,500 tons or more, and torpedo craft of over 50 tons.

RELATIVE STRENGTH OF THE TRIPLE ENTENTE AND DUAL ALLIANCE.

Type of Vessel.	Great Britain.		France.		Russia.		Germany.		Austria.		Triple Entente.		Dual Alliance.	
	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.
Dreadnoughts	31	661,650	4	92,368	..	.....	16	351,519	3	60,030	35	754,018	19	411,549
Pre-dreadnoughts	40	589,385	18	262,675	7	98,750	20	242,800	6	74,613	66	950,810	26	317,413
Coast defense ships	...	.....	1	8,800	2	10,380	2	8,168	6	41,700	3	19,180	8	49,868
Armored cruisers	34	406,800	20	201,724	6	63,500	9	94,245	2	13,380	60	672,024	11	107,625
Cruisers	74	382,815	9	46,095	9	52,845	41	150,747	5	13,815	92	481,755	46	164,562
Destroyers	167	125,850	84	35,812	91	36,748	130	67,094	18	9,450	342	198,410	148	76,544
Torpedo boats	49	11,488	135	13,426	14	2,132	...	.....	39	6,852	198	27,046	39	6,852
Submarines	75	30,362	64	27,940	30	6,506	21	14,140	6	1,686	169	64,808	27	15,826
Total tons completed		2,208,350		688,840		270,861		928,713		221,526		3,168,051		1,150,239

Tables showing relative strength of Triple Entente and Dual Alliance.



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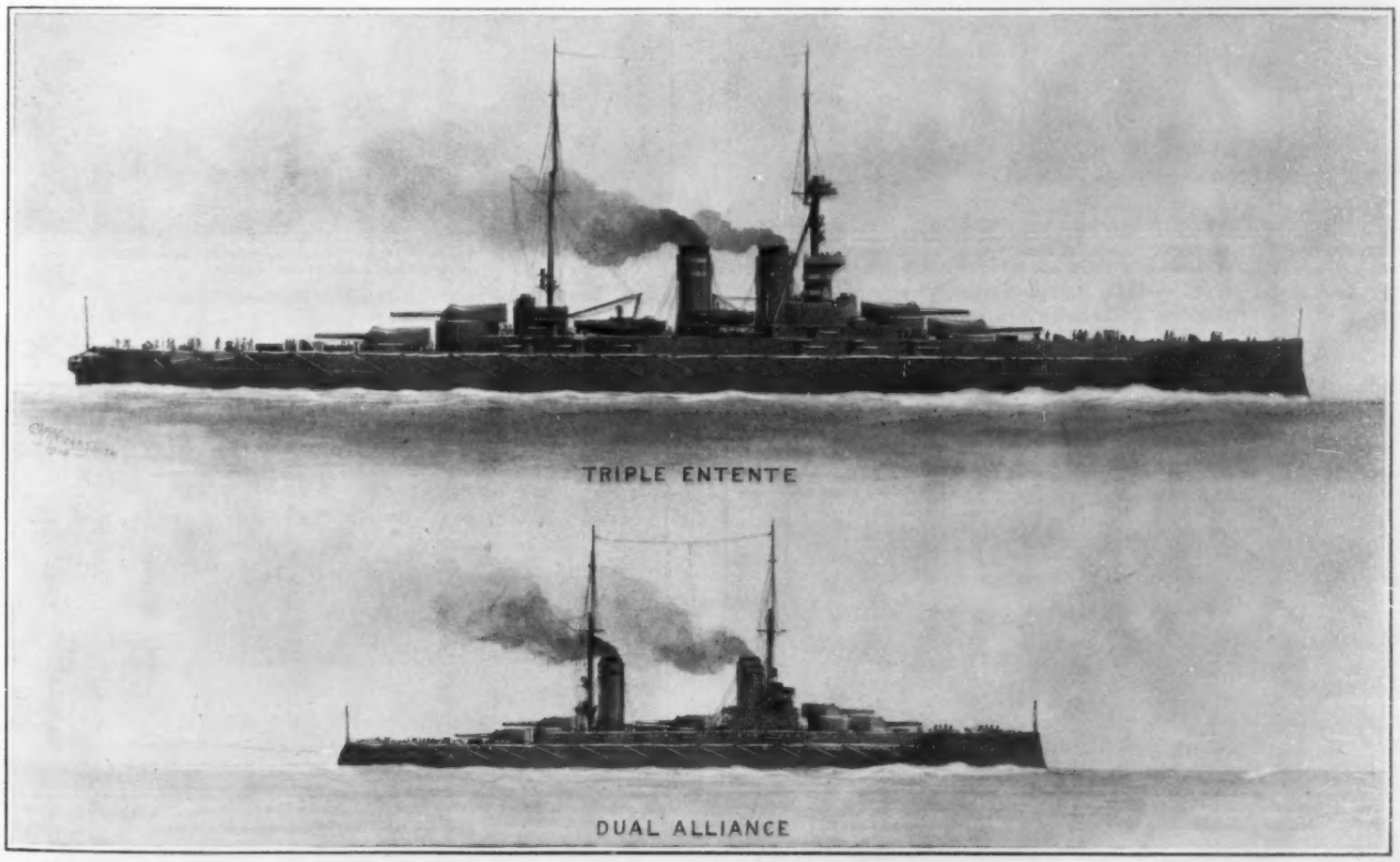
Relative strength of complete navies of Triple Entente and Dual Alliance, shown by relative length of ships and guns.



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Relative strength of allied navies in dreadnoughts, shown by relative length of ships.

The Mistress of the Seas

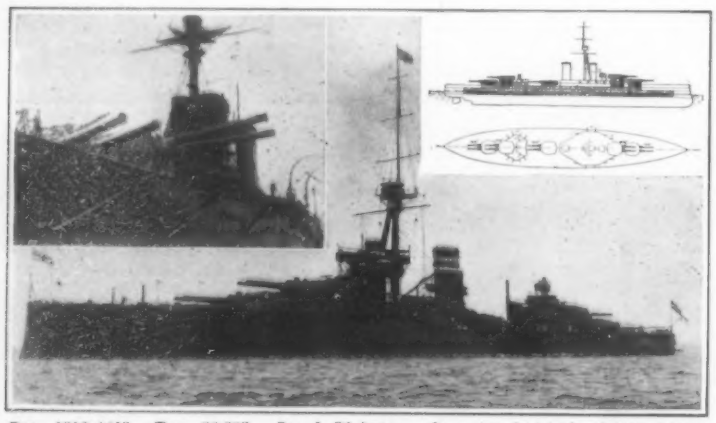
Great Britain's Overpowering Navy

Date, 1914. **Tons,** 25,000. **Speed,** 21½ knots. **Guns:** Ten 13.5-inch; twelve 6-inch. **Torpedo tubes,** 4. **Side armor,** 12-inch—10-inch.

Dreadnoughts: "Iron Duke" (flagship); "Marlborough"; "Benbow"; "Emperor of India."

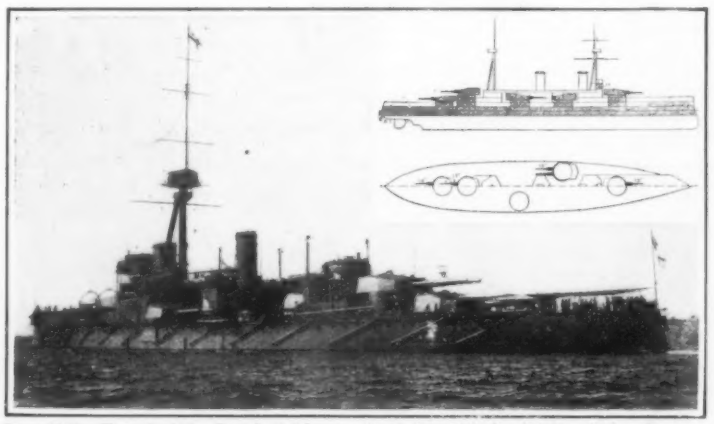
THE British fleet, composed of nearly five hundred ships of an aggregate displacement of about two and one quarter million tons, is the military force which binds together and preserves intact that vast aggregation of countries and peoples known as the British Empire. Great as it is, the British Navy is not by any means excessive; it merely measures up to the enormous responsibilities that are laid upon it. So far as the British Isles are concerned, its purpose and scope are exactly the same as those, let us say, of the great German army, namely, to afford complete security from attack by hostile nations. So long as Great Britain's navy is sufficiently powerful to maintain the command of the seas, her shores can be maintained inviolate, and she can pursue her activities as a great manufacturing and commercial nation, free from the burden of those enormous conscript armies which have proved so burdensome to the nations on the continent of Europe. In this respect, the situation of the British Isles is similar to that of the United States. It is our policy, or at least it should be, to maintain a navy sufficiently strong to discourage any foreign power from sending its fleet across the sea to engage us with any hope of success.

The duties of the British navy, however, do not end with the mere protection of the British Isles from invasion; for to the navy falls the work of protecting Great Britain's enormous seaborne commerce; and hence we find that the list of her ships includes over one hundred fast and powerful cruisers, to which in the



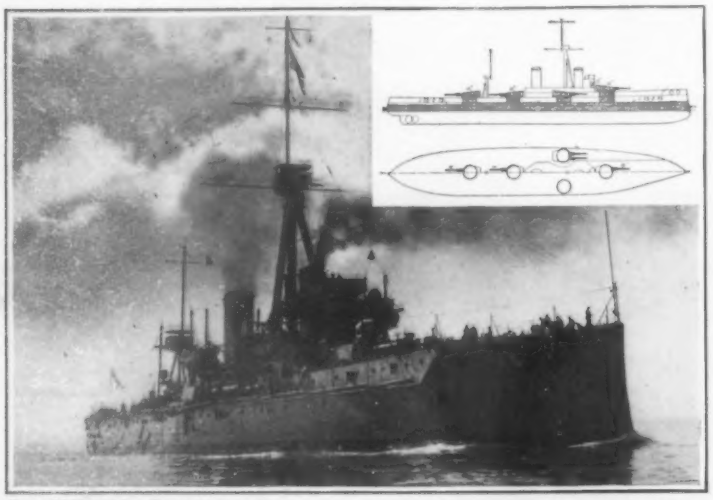
Date, 1912–1913. **Tons,** 23,000. **Speed,** 22 knots. **Guns,** ten 13.5-inch, sixteen 4-inch. **Torpedo tubes,** 3. **Side armor,** 12-inch, 9-inch, 8-inch.

Dreadnoughts: "Orion"; "Conqueror"; "Monarch"; "Thunderer"; "Ajax"; "Audacious"; "Centurion"; "King George V."



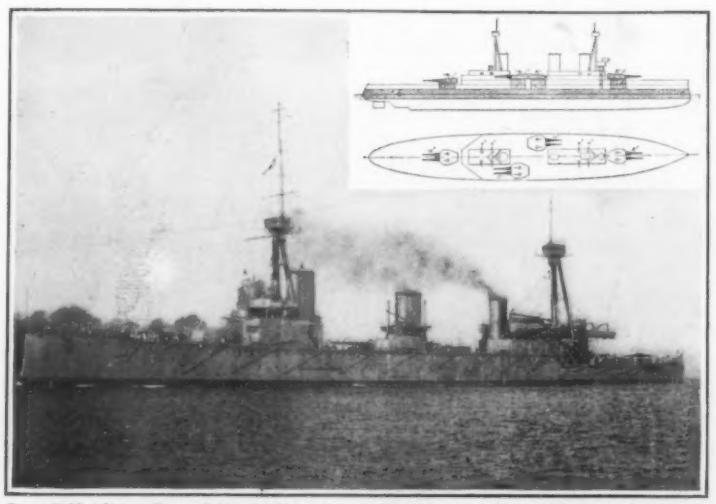
Date, 1911. **Tons,** 20,000. **Speed,** 21.5 knots. **Guns,** ten 12-inch, sixteen 4-inch. **Torpedo tubes,** 3. **Side armor,** 11-inch—8-inch.

Dreadnoughts: "Hercules"; "Neptune"; "Colossus."



Date, 1906–1910. **Tons,** 18,000—19,250. **Speed,** 22—21.8 knots. **Guns,** ten 12-inch, eighteen 4-inch; original "Dreadnought," twenty-four 3-inch. **Torpedo tubes,** 3. **Side armor,** 11-inch, 10-inch, 8-inch.

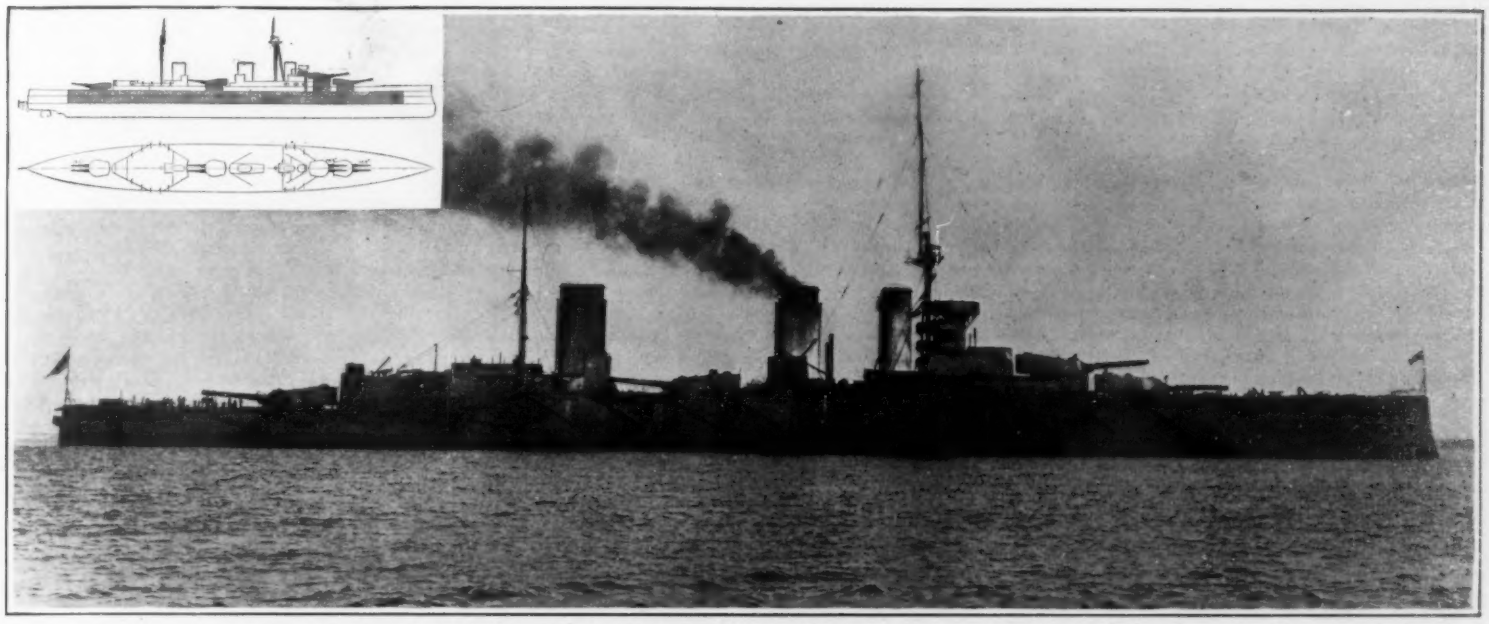
Dreadnoughts: "Dreadnought"; "Bellerophon"; "Temeraire"; "Superb"; "Collingwood"; "St. Vincent"; "Vanguard."



Date, 1909–1911. **Tons,** 17,250–18,750. **Speed,** 27–28 knots. **Guns,** eight 12-inch, sixteen 4-inch. **Torpedo tubes,** 3. **Side armor,** 8-inch, 7-inch.

Battle-cruisers: "Indefatigable"; "New Zealand"; "Australia"; "Invincible"; "Inflexible"; "Indomitable."

Photos by Stephen Cribb, Symonds & Co., and E. W. C. Hoskins.



Date, 1913. **Tons,** 26,350–27,000. **Speed,** 28–29 knots. **Guns,** eight 13.5-inch, sixteen 4-inch. **Torpedo tubes,** 3. **Side armor,** 9-inch.

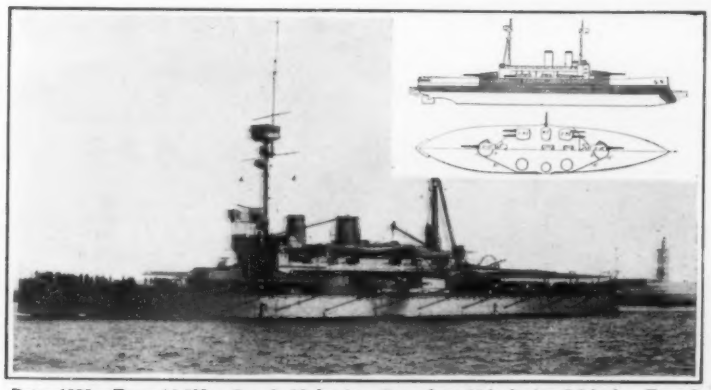
Battle cruisers: "Queen Mary"; "Lion"; "Princess Royal."

event of war falls the duty of patrolling the ocean lines of travel, seeking out and destroying the cruisers of the enemy, and making it possible for her vast fleet of merchant ships to carry her exports abroad and bring in products and supplies from foreign nations, of which latter, during hostilities, her greatly needed food supply would form the most valuable part.

Already, although the war is but a month old, not only has the German fleet been forced out of the North Sea and into the shelter of the Baltic and Germany's home ports, but the cruisers and commerce destroyers of the enemy have either been driven from the trade routes or are being so closely followed and harried, that they have ceased to be a menace to British, French, and Russian shipping. Furthermore, so secure does Great Britain feel behind the protecting arm of her fleet, that she is sending the whole of her trained army to the Continent, and making ready to follow with several hundred thousand auxiliary troops, which can be recruited, trained, and shipped to the field of war without any fear of molestation.

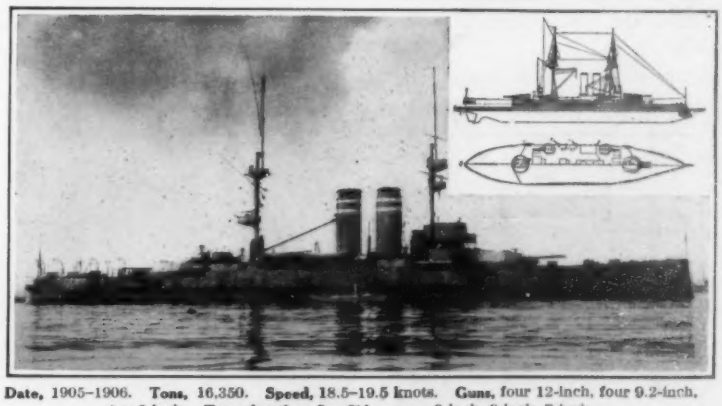
The first fighting line of the British navy is made up of no less than 31 ships of the dreadnought class, the earliest of which—the original dreadnought—is now not more than eight years old. All of these ships have a speed of from 21½ to 22 knots, and their displacement varies from 18,000 to 25,000 tons. The first seven follow the lines of the original "Dreadnought." They were launched between 1906 and 1910. They mount ten 12-inch guns in five turrets, three on the center line and one on each beam. The belt armor is 11 inches in thickness, and there is an upper belt above this of 8-inch armor. Following these, come the three dreadnoughts of the "Hercules" class, of 20,000 tons and 21.5 knots speed. They carry ten 12-inch guns and a torpedo battery of sixteen 4-inch guns, or two less than the torpedo battery of the preceding dreadnought ships, which mount for torpedo defense a battery of eighteen 4-inch guns. The turrets are disposed: three on the center line of the ship, and two amidships, placed diagonally. This arrangement gives an end-on fire at bow and stern of six 12's and a broadside of ten 12's. In respect of broadside fire these three ships are superior to the earlier dreadnoughts, above-mentioned, which suffer from the serious defect that one of the broadside turrets with its two guns is masked by the super-structure, leaving only eight guns available on each broadside. To these ships must be added the dreadnought "Osman I," built for Turkey and taken over by the British government after the declaration of war. This fine vessel, of 27,500 tons and 23 knots speed, carries the unusual battery of fourteen 12-inch guns in seven turrets, all mounted on the center line. She is protected by a 9-inch belt and 6-inch upper belt, and she carries a heavy torpedo-defense battery of twenty 6-inch guns.

In 1912 and 1913 Great Britain completed eight dreadnoughts of 23,000 tons and 22 knots speed, which are armed with ten of the new 13.5-inch guns, mounted in five turrets on the center line. The side armor was increased in extent, consisting of a 12-inch water line belt, with 9-inch and 8-inch side armor above. These ships marked a great advance upon their predecessors,



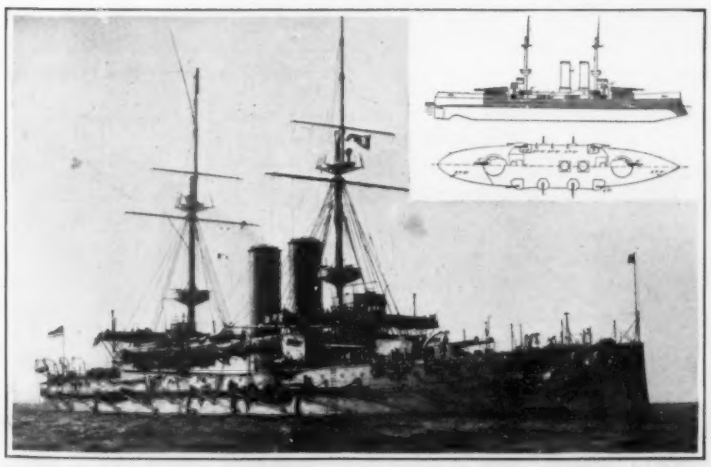
Date, 1908. **Tons,** 16,500. **Speed,** 19 knots. **Guns,** four 12-inch, ten 9.2-inch. **Torpedo tubes,** 5. **Side armor,** 12-inch—8-inch.

Semi-dreadnoughts: "Lord Nelson"; "Agamemnon."



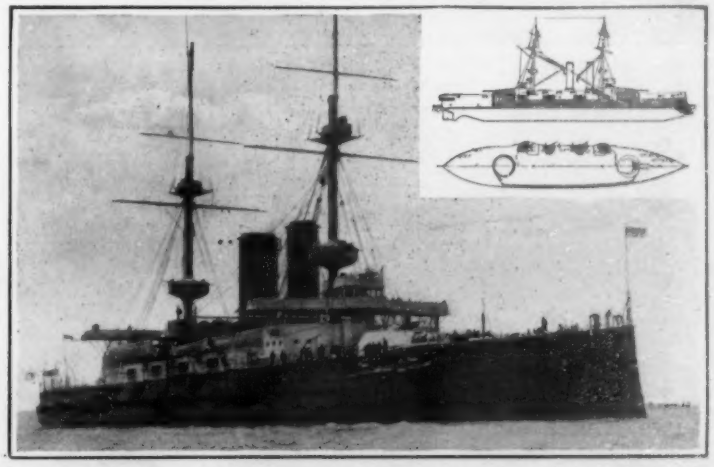
Date, 1905–1906. **Tons,** 16,350. **Speed,** 18.5–19.5 knots. **Guns,** four 12-inch, four 9.2-inch, ten 6-inch. **Torpedo tubes,** 5. **Side armor,** 9-inch, 8-inch, 7-inch.

Semi-dreadnoughts: "King Edward VII"; "Africa"; "Britannia"; "Commonwealth"; "Dominion"; "Hibernia"; "Hindustan"; "Zealandia."



Date, 1903–1904. **Tons,** 14,000. **Speed,** 19 knots. **Guns,** four 12-inch, twelve 6-inch. **Torpedo tubes,** 4. **Side armor,** 7-inch.

Pre-dreadnoughts: "Cornwallis"; "Duncan"; "Albemarle"; "Exmouth"; "Russell."



Date, 1901–1904. **Tons,** 15,000. **Speed,** 18–18.5 knots. **Guns,** four 12-inch, twelve 6-inch. **Torpedo tubes,** 4. **Side armor,** 9-inch.

Pre-dreadnoughts: "London"; "Formidable"; "Bulwark"; "Implacable"; "Irresistible"; "Prince of Wales"; "Queen"; "Venerable."

Photos by Stephen Cribb, Symonds & Co., and E. W. Hopkins.

the shell of the 13.5 gun weighing 1,400 pounds as against a weight of 850 pounds for the 12-inch gun, and the energy has gone up from 50,000 tons to 70,000 tons. In the next following ships of the "Iron Duke" class—finished in 1914—the displacement was increased to 25,000 tons. The main armament is the same, namely ten 13.5-inch guns, and the torpedo defense battery has been increased in power by substituting twelve 6-inch for sixteen 4-inch. The side armor is heavier, consisting of a 12-inch belt with 10 inches of armor from the belt to the upper deck. To these four ships must be added the dreadnought "Reshadieh," built for Turkey and taken over by the British government on the declaration of war, a ship of 23,000 tons and 21 knots speed, carrying an armament of ten 13.5-inch guns and sixteen 6-inch guns.

In addition to the dreadnoughts above mentioned, there are six battle-cruisers of the "Indefatigable" type, ships of from 17,250 tons to 18,750 tons and having speeds of from 27 to 28 knots, and side armor from 8 to 7 inches in thickness. Each of these ships carries eight 12-inch guns in four turrets, one forward and one aft on the center line and one on each broadside, arranged diagonally. The latest ships of the battle-cruiser type are the "Queen Mary," the "Lion," and the "Princess Royal," of 26,350 to 27,000 tons, with a speed of from 28 to 29 knots, and side armor 9 inches in thickness. Each of these ships carries eight 13.5-inch guns in four turrets arranged on the center line.

Summing up then, the first fighting line of the British navy consists of 31 ships, 15 of which are armed with 12-inch guns and 16 with the 13.5-inch gun.

Next in fighting value to the dreadnoughts are the 10 ships of the "Lord Nelson" and "King Edward VII" classes, which ships might justly be termed semi-dreadnoughts, as coming intermediately in gun power between the pre-dreadnoughts and the dreadnoughts. The 16,500-ton "Lord Nelson" and "Agamemnon," completed in 1908, are of 19 knots speed, and carry four 12-inch and ten 9.2-inch guns all in turrets, the 12-inch being mounted in twin-gun turrets forward and aft, and the 9.2's in turrets on the broadside. The eight ships of the "King Edward" class completed in 1905 and 1906 are of 16,350 tons and 18.5 to 19.5 knots speed, and their main armament consists of four 12-inch and four 9.2-inch, with a secondary battery of ten 6-inch.

The remainder of the battleships of the British navy, 30 in number, are pre-dreadnoughts pure and simple. The latest of these, of the "Duncan" class, are of 14,000 tons, with a speed of 19 knots, and they are armed with four 12-inch and twelve 6-inch guns. They suffer from the defect that their side armor, 7 inches in thickness, is too light for ships of the battleship class. Better vessels are the 8 ships of the "London" class, completed between 1901 and 1904. They are of 15,000 tons, with a speed of from 18 to 18½ knots. They are armed with four 12- and twelve 6-inch guns, their side armor being 9 inches in thickness. The illustrations of these two classes, herewith given, will serve to give a fairly correct idea of the other ships of the pre-dreadnought classes as to the disposition of guns.

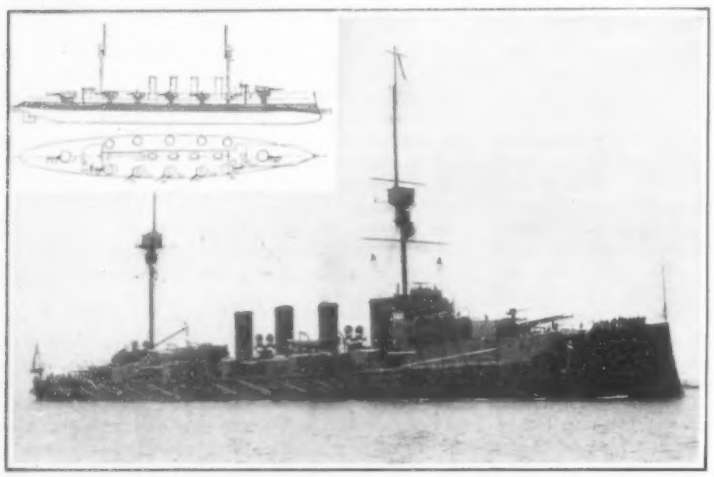
The British navy is strong in the armored-cruiser class, and we present illustrations of two of the finest types, the "Cochrane," of 13,550 tons and 23.3 knots speed, carrying six 9.2-inch and four 7.5-inch guns; and the "Minotaur" of 14,600 tons carrying four 9.2-inch and ten 7.5-inch guns. Both are protected with 6-inch belts. There are 6 ships of the "Cochrane" type and 3 of the "Minotaur." We also show a view of the "Antrim," representing a class of six armored cruisers of 10,850 tons and 22 to 23.5 knots speed, carrying four 7.5-inch and six 6-inch guns and protected by 6 inches of armor.

Great Britain possesses 74 cruisers of the unarmored type; that is vessels which carry no side armor, but depend upon the protective deck at the water-line for keeping shot and shell out of the engine rooms and magazines. To-day, the most important cruisers are those of the fast scout type, represented by the "Chatham." These are vessels of 5,400 tons, having a speed of 25.5 knots, and carrying eight 6-inch guns.

Such scouts as England possesses are not quite as fast as could be wished, and in this respect they are inferior to the German scouts of the "Breslau" type, which are good for 27 to 27½ knots. Great Britain, however, is building a large number of these of from 27 to 30 knots speed, which will become available as the war proceeds.

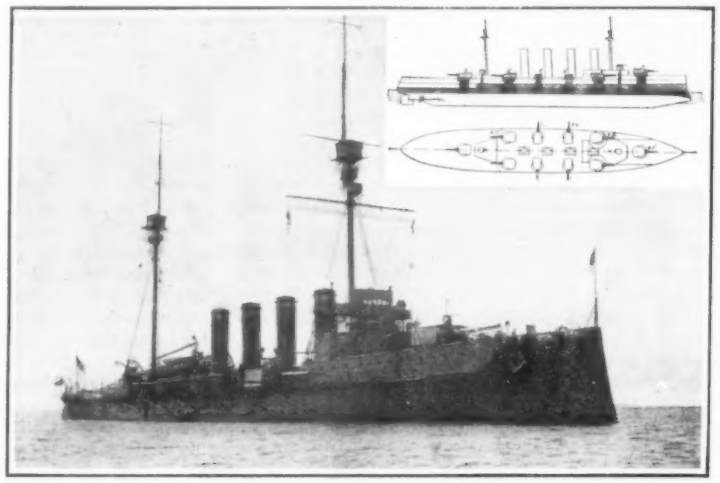
Of torpedo-boat destroyers the navy possesses 167, and of torpedo boats, 49. We illustrate the "Mohawk,"

(*Concluded on page 198.*)



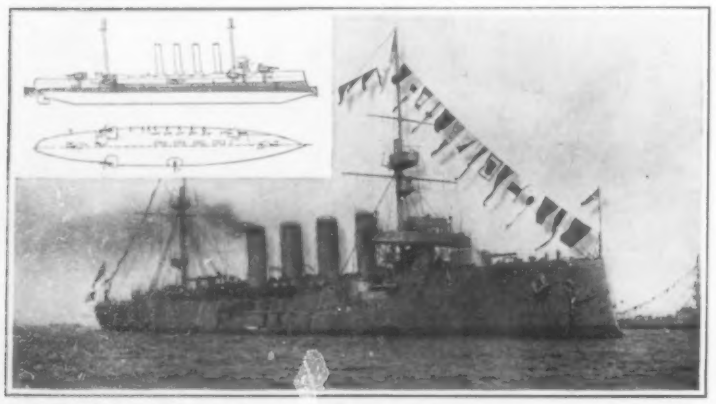
Date, 1908. **Tons,** 14,600. **Speed,** 22.5–23 knots. **Guns,** four 9.2-inch, ten 7.5-inch. **Torpedo tubes,** 5. **Side armor,** 6-inch.

Armored cruisers: "Minotaur"; "Defense"; "Shannon."



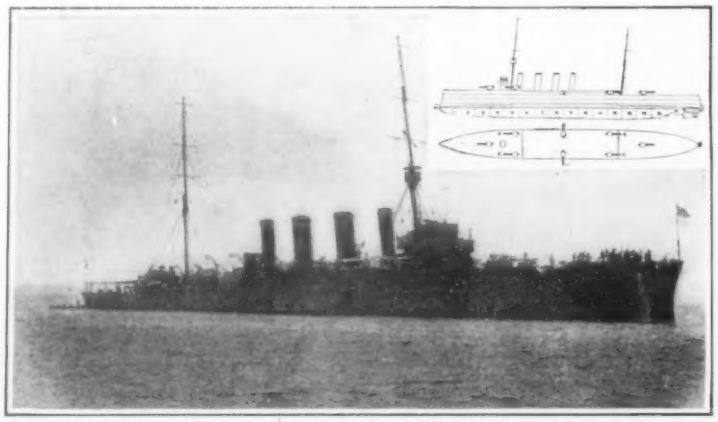
Date, 1906–1907. **Tons,** 13,550. **Speed,** 23.3 knots. **Guns,** six 9.2-inch, four 7.5-inch. **Torpedo tubes,** 3. **Side armor,** 6-inch.

Armored cruisers: "Cochrane"; "Achilles"; "Natal"; "Warrior"; "Duke of Edinborough";* "Black Prince."*



Date, 1905–1906. **Tons,** 10,850. **Speed,** 22–23.5 knots. **Guns,** four 7.5-inch, six 6-inch. **Torpedo tubes,** 2. **Side armor,** 6-inch.

Armored cruisers: "Antrim"; "Devonshire"; "Argyll"; "Carnarvon"; "Hampshire"; "Roxburgh."



Date, 1912–1913. **Tons,** 5,400. **Speed,** 25.5 knots. **Guns,** eight 6-inch. **Torpedo tubes,** 2. **Armor,** 3-inch deck.

Scout cruisers: "Chatham"; "Southampton"; "Dublin"; "Nottingham";† "Birmingham";* "Lowestoft."†

Date, 1907. **Tons,** 865. **Speed,** 34.5 knots. **Guns,** five 3-inch. **Torpedo tubes,** 2.

Torpedo-boat destroyers: "Mohawk"; "Afridi"; "Cossack"; "Ghurka"; "Tartar."

Date, 1911. **Tons,** 600. **Speed,** 16 surface, 10 submerged knots. **Torpedo tubes,** 3. **Guns,** two 3-inch. **Radius,** 4,000 miles.

Submarines: The "D" class of eight boats.

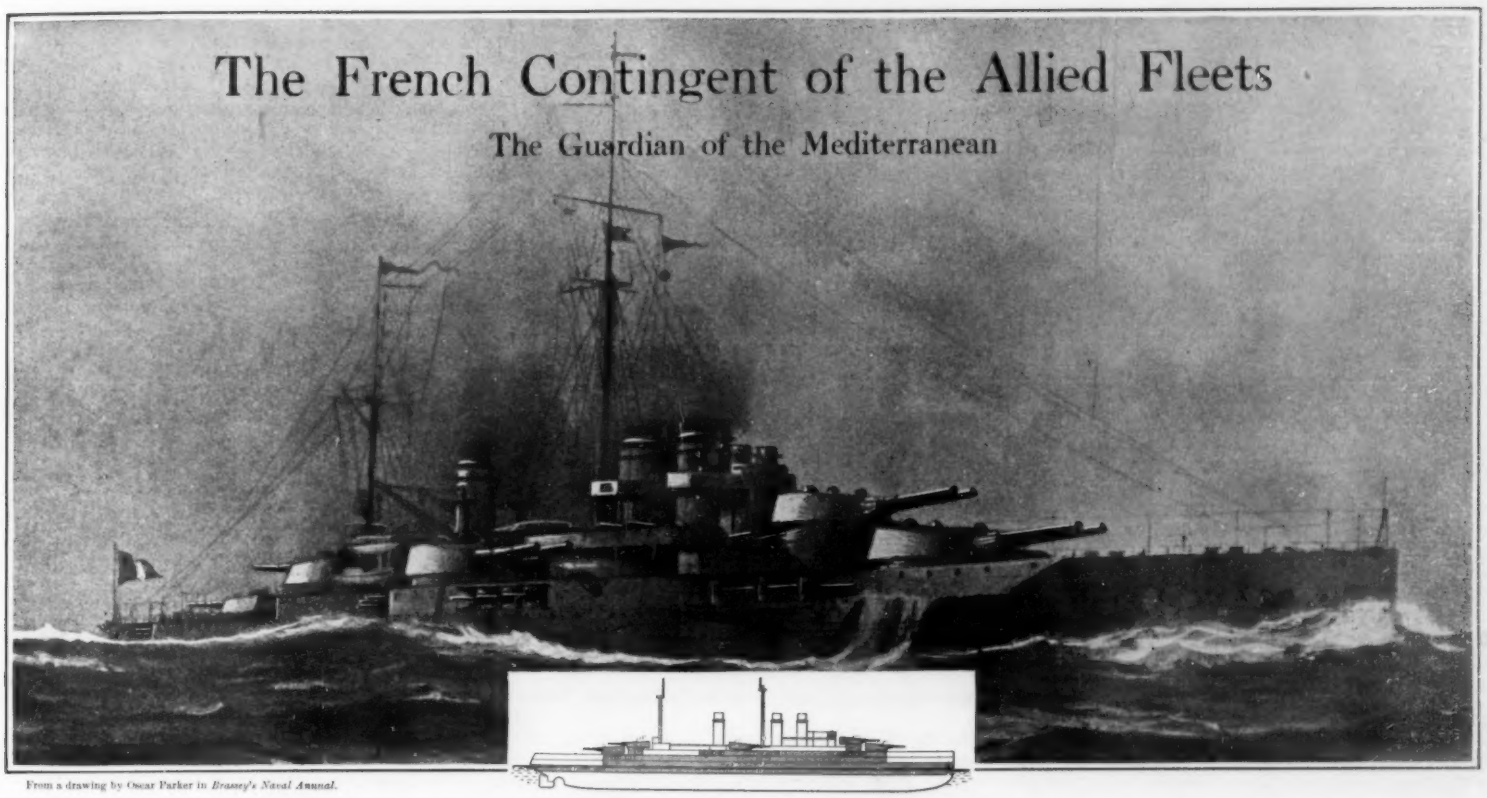
* These ships carry ten 6-inch in place of four 7.5-inch.

† These have also 2-inch side armor.

Photos by Stephen Cribb, Symonds & Co., and E. W. Hopkins.

The French Contingent of the Allied Fleets

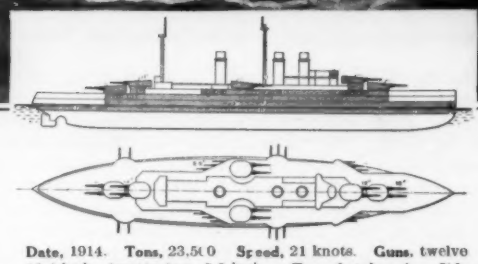
The Guardian of the Mediterranean



From a drawing by Oscar Parker in *Brassey's Naval Annual.*

TO the French navy has fallen the duty of safeguarding the interests of the Triple Entente in the Mediterranean; and in view of the excellent quality of the small but formidable dreadnought and semi-dreadnought fleet of Austria, it is probable that the whole of the French first fighting line is concentrated in those waters. It will be the work of the French fleet to find and destroy the ships of the Austrian navy, and to assist in the reduction and capture of the Austrian naval bases. That accomplished, practically the whole of her fleet will be available to co-operate with the British fleet in the destruction of the German navy and the capture of the naval ports on the North Sea and in the Baltic.

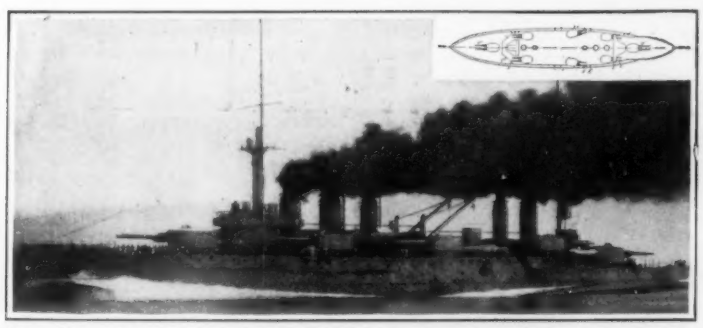
Although France has a large programme of new construction in hand, she possesses at present only the four dreadnoughts of the "Jean Bart" class, namely, the "Jean Bart," the "Courbet," the "France," and the "Paris." These are formidable ships of 23,500 tons and 21 knots speed, carrying twelve 13.4-inch guns in six turrets. Two of the turrets are arranged on the center line forward and two aft, after the American plan, initiated on our "Michigan." The other two turrets are carried, one on each beam, and this disposition permits of the very heavy end-on fire both forward and aft of no less than eight 13.4-inch guns, and a broadside fire of ten such pieces. The main belt is 11 inches thick, and there is an upper belt of 7-inch armor. These 4 ships have been completed during the present year.



Date, 1914. **Tons,** 23,500 **Speed,** 21 knots. **Guns,** twelve 13.4-inch, twenty-two 5.5-inch. **Torpedo tubes,** 4. **Side armor,** 11-inch—7-inch.

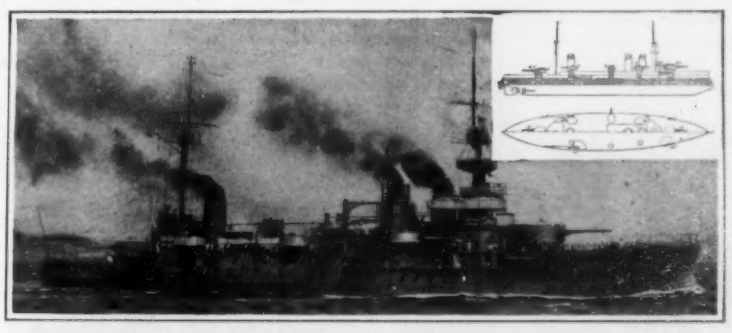
Dreadnoughts: "Jean Bart"; "Courbet"; "France"; "Paris."

In 1911 France added to her navy 6 ships of the "Voltaire" semi-dreadnought class. These are of 18,400 tons displacement, with a speed of from 19½ to 20½ knots. They carry four 12-inch guns in two turrets forward and aft, and the heavy broadside battery of



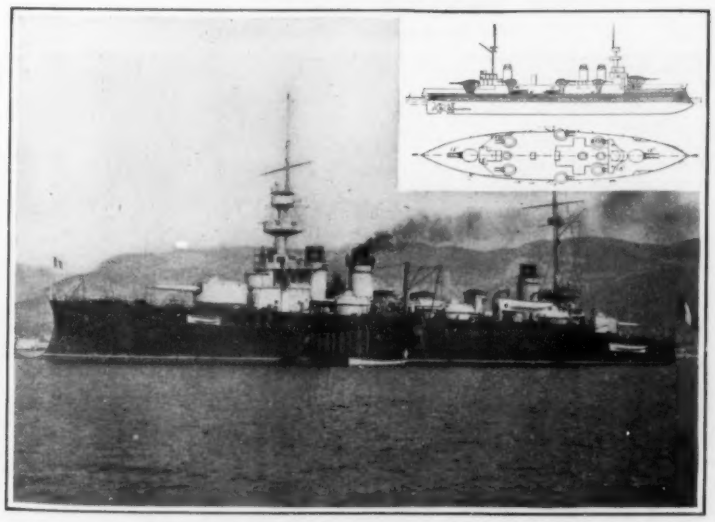
Date, 1911. **Tons,** 18,400. **Speed,** 19.5–20.5 knots. **Guns,** four 12-inch, twelve 9.4-inch. **Torpedo tubes,** 2. **Side armor,** 10-inch—9-inch.

Semi-dreadnoughts: "Voltaire"; "Danton"; "Condorcet"; "Diderot"; "Mirabeau"; "Vergniaud."



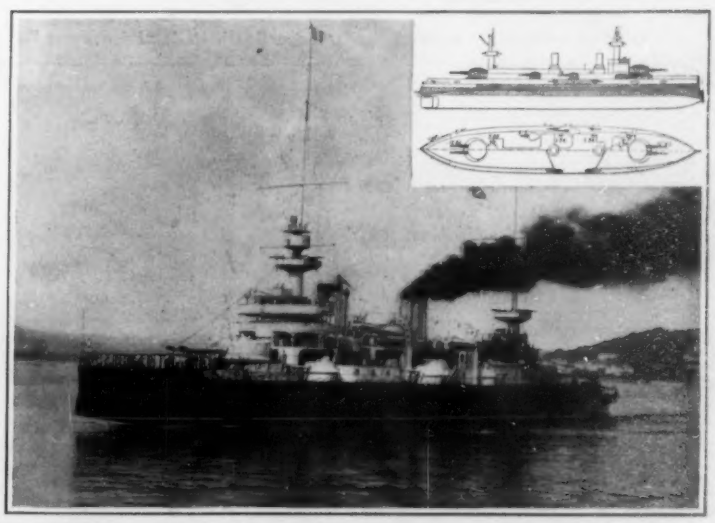
Date, 1907–1908. **Tons,** 14,900. **Speed,** 19.4 knots. **Guns,** four 12-inch, ten 7.6-inch. **Torpedo tubes,** 4. **Side armor,** 11-inch.

Pre-dreadnoughts: "Justice"; "Democratic"; "Verite."



Date, 1906. **Tons,** 14,700. **Speed,** 19 knots. **Guns,** four 12-inch, eighteen 6.4-inch. **Torpedo tubes,** 5. **Side armor,** 11-inch.

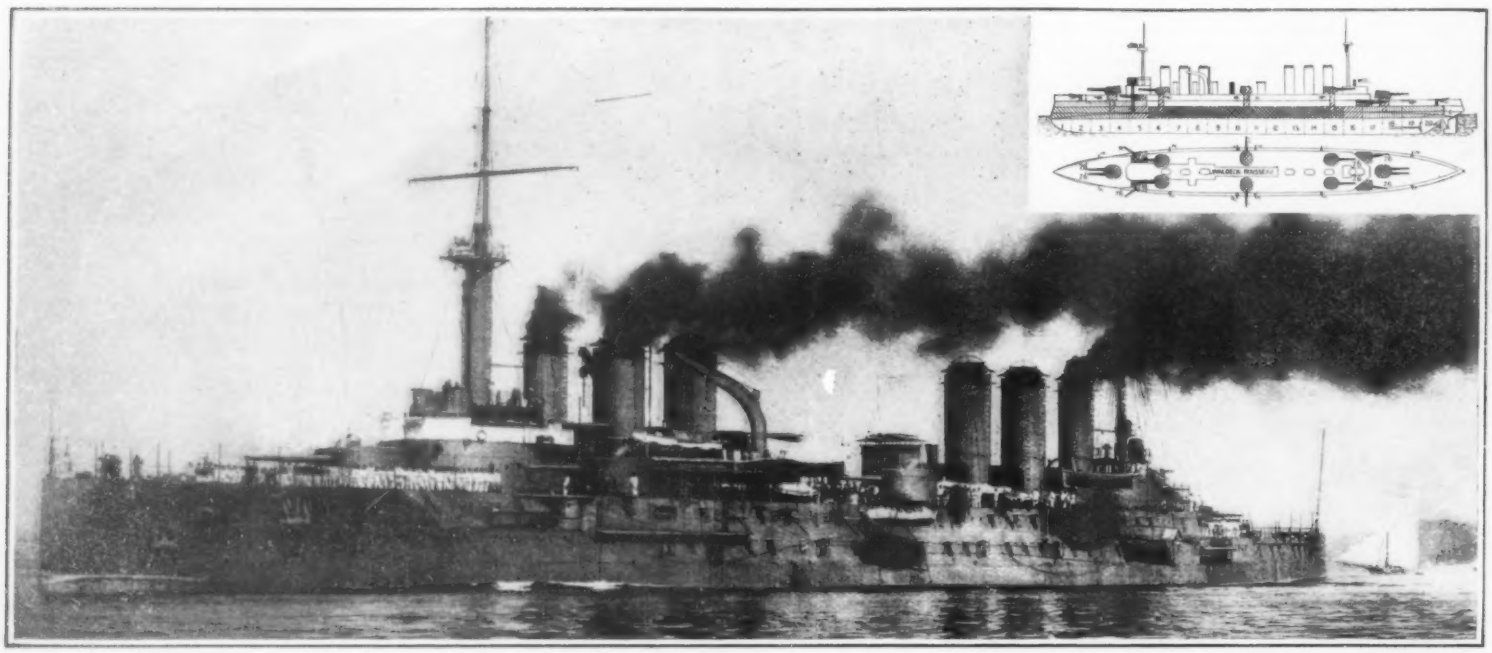
Pre-dreadnoughts: "Republique"; "Patrie."



Date, 1903. **Tons,** 12,750. **Speed,** 18 knots. **Guns,** four 12-inch, ten 6.5-inch. **Torpedo tubes,** 4. **Side armor,** 12-inch—5¼-inch.

Pre-dreadnought: "Suffren."

Photos by M. Bar, J. Kuhn, and Stephen Cribb.



Date, 1910. **Tons,** 14,000. **Speed,** 23.9 knots. **Guns,** fourteen 7.6-inch. **Torpedo tubes,** 2. **Side armor,** 6¾-inch.

Armored Cruisers: "Edgar Quinet"; "Waldeck Rousseau."

twelve 9.4-inch guns is mounted in six turrets. The side armor is 10 and 9 inches in thickness. The "Jean Barts" and "Voltaires" would be more than a match for the three Austrian dreadnoughts of the "Viribus Unitis" class and the three semi-dreadnoughts of the "Franz Ferdinand" class, which are described in the chapter on the Austrian navy. Of the remaining 12 French pre-dreadnoughts, the most important ships are those of the "Justice" and the "Republique" classes. These are of about 14,800 tons displacement and 19 knots speed. The "Justice" carries four 12-inch guns forward and aft, and ten 7.6-inch guns on the broadside, six of them in single gun turrets and four in casemates. The "Republique" and "Patrie" are armed with four 12-inch guns and eighteen 6.4-inch, the latter being mounted on the broadside in six armored turrets. These five ships have water-line protection of 11 inches of armor.

The earlier pre-dreadnoughts, such as the "Suffren," "Boudet," and "Jaureguiberry" carry a main armament of two 12-inch and two 10.8-inch guns, with broadside secondary batteries and 5.5- and 6.5-inch pieces.

Unquestionably the most picturesque feature of the French navy is the armored cruisers, some of which, like the "Edgar Quinet," have no less than six smoke-stacks, which, though they may be attractive to the public eye, would present an equally attractive target to the enemy. The "Edgar Quinet" and "Waldeck Rousseau" are the finest of the 20 ships of the armored-cruiser class. They are of 14,000 tons, and about 24 knots speed, and are protected by 6¾ inches of belt armor. In these, as in all the French armored cruisers, the battery is rather light, the 7.6-inch gun being the heaviest piece carried. Except in this particular, however, the French armored cruisers are very serviceable ships, well protected and showing a good turn of speed. They are doing excellent service in the present war, in running down the German and Austrian cruisers, and in capturing and driving into neutral ports the merchant ships of the enemy.

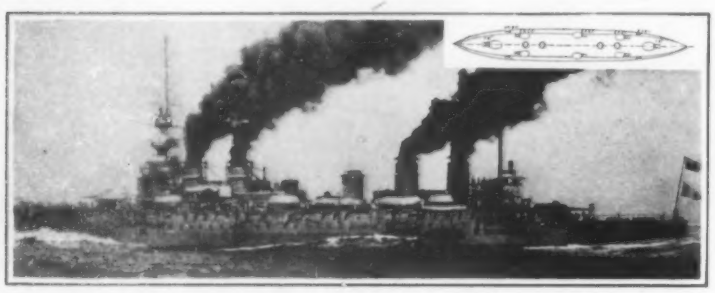
In the protected-cruiser class, the French navy is rather weak, possessing only 9 ships of this type.

When we come to the torpedo-boat destroyer and submarine service, however, we find that the French navy is remarkably well equipped, possessing 84 destroyers and no less than 135 torpedo boats. On the average, the French destroyers are smaller than those of the other nations; although of late years the French have been building in larger sizes and have turned out for their navy some of the fastest vessels of this class afloat.

The submarine fleet of the French navy is very large, consisting of 64 boats, and we believe that this service is highly efficient. When the Austrian navy shall have been disposed of, the destroyer and submarine fleets of the French will no doubt play a very important part in the campaign for the capture or destruction of the German fleet in the Baltic.

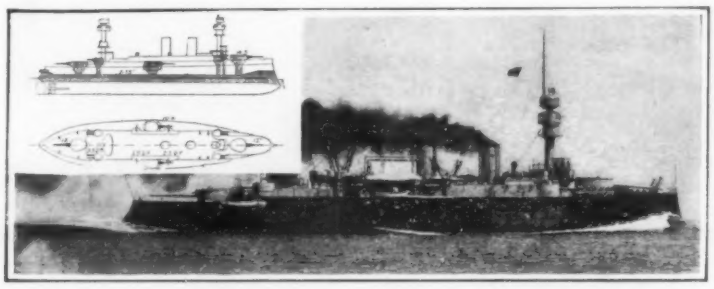
A Novel Electromechanical Movement

AT the recent Conversazione of the Royal Society, Mr. W. M. Mordey exhibited an electrically driven pendulum or balance wheel without any make-and-break, commutator, or equivalent device. A simple one-phase alternate-current induction motor with a rotor having a short-circuited winding, in the field of a stator excited by alternate-current, develops a torque which is always in the direction of motion. If provided with a pendulum, or with a spring in the manner of a balance wheel, the rotor, if set in motion, will continue to oscillate, friction and other losses, or any load put on it, being made up by energy taken from the circuit.



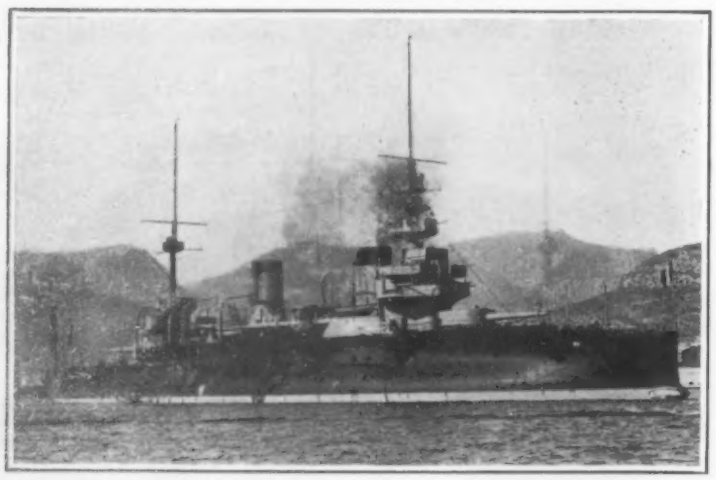
Date, 1906. **Tons,** 12,400. **Speed,** 23 knots. **Guns,** four 7.6-inch, sixteen 6.4-inch. **Torpedo tubes,** 5. **Side armor,** 6¾-inch.

Armored cruisers: "Victor Hugo"; "Leon Gambetta"; "Jules Ferry."



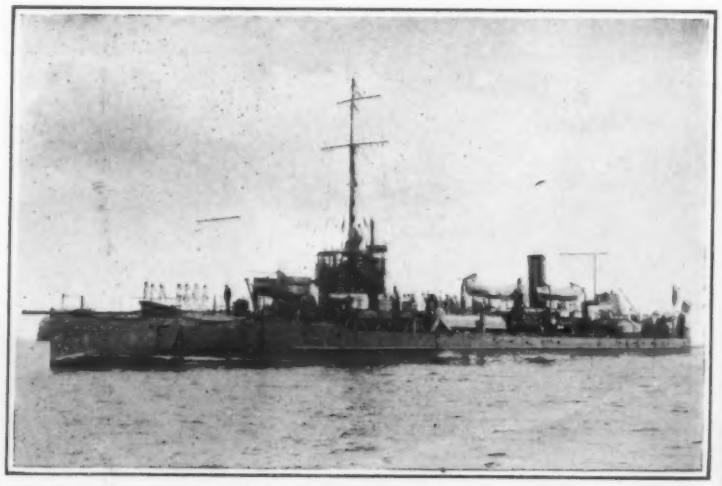
Date, 1893. **Tons,** 11,900. **Speed,** 17.8 knots. **Guns,** two 12-inch, two 10.8-inch, eight 5.5-inch. **Torpedo tubes,** 2. **Side armor,** 17¾-inch—9¾-inch.

Pre-dreadnought: "Jaureguiberry.



Date 1896. **Tons,** 12,250. **Speed,** 17 knots. **Guns,** two 12-inch, two 10.8-inch, eight 5.5-inch. **Torpedo tubes,** 4. **Side armor,** 16-inch—4-inch.

Pre-dreadnought: "Bouvet."



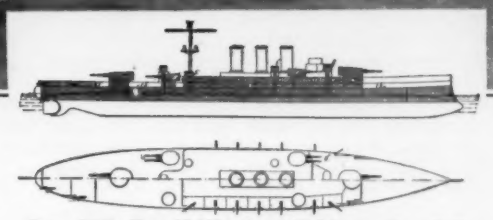
Date, 1908. **Tons,** 430. **Speed,** 28 knots. **Guns,** one 9-pounder, six 3-pounders. **Torpedo tubes,** 3.

Torpedo-boat destroyer: "Fanion."

Photos by M. Bar, J. Kuhn and Stephen Cribb.

Russian Navy in the Baltic

Many Dreadnoughts Building—None in Commission



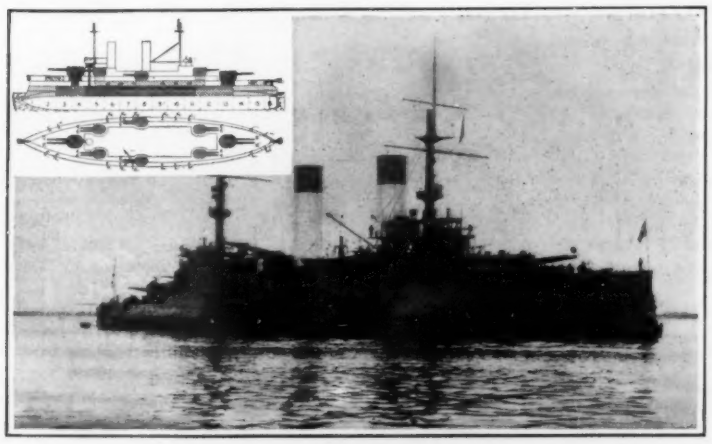
Date, 1907. **Tons,** 15,000. **Speed,** 21.5 knots. **Guns,** four 10-inch, eight 8-inch, twenty 4.7-inch. **Torpedo tubes,** two. **Side Armor,** 6-inch—3-inch.

Armored cruiser: "Rurik."

THE great War of the Nations has come two or three years too soon for the Russian Navy, which, so far as its first fighting line is concerned, is still in the making. The Japanese War practically wiped out the capital ships of the Russian fleet, and it was only in 1909 that she set about the recreation of her navy upon modern lines. In that year she laid down four dreadnoughts, of 23,300 tons, which are to steam 23 knots, and will mount a battery of twelve 12-inch guns in four three-gun turrets. In 1912 she laid down four huge armored cruisers of 32,000 tons and 27 knots speed, which are to carry a battery of twelve 14-inch guns. Unless the war should be long drawn out, these ships are unlikely to see any active service. Three dreadnoughts, of 22,500 tons, carrying ten 12-inch guns, are being built in the Black Sea.

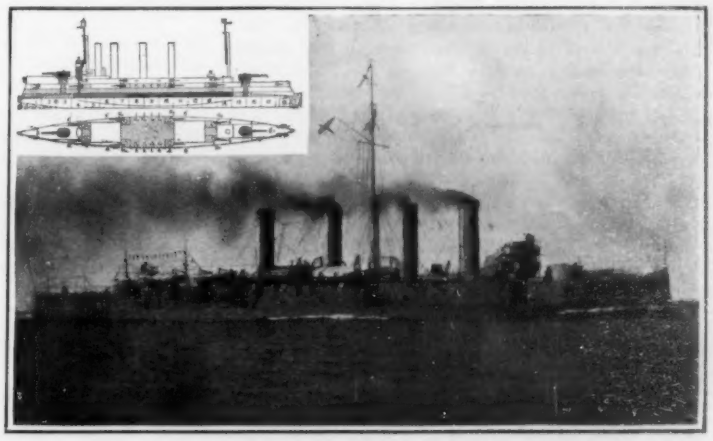
The summary of the strength of the navies engaged in the war, given on page 174 of this issue, credits Russia with no dreadnoughts, 7 pre-dreadnoughts, 2 coast defense vessels, no battle-cruisers, 6 armored cruisers, 9 protected cruisers, 91 destroyers, 14 torpedo boats, and 30 submarines; but it should be remembered that this enumeration includes the Black Sea fleet, whose operations are limited by treaty to those waters, and the vessels of the Asiatic squadron. The present article is concerned with the Baltic fleet, whose ships alone are available for operations in the present war.

(Concluded on page 198.)



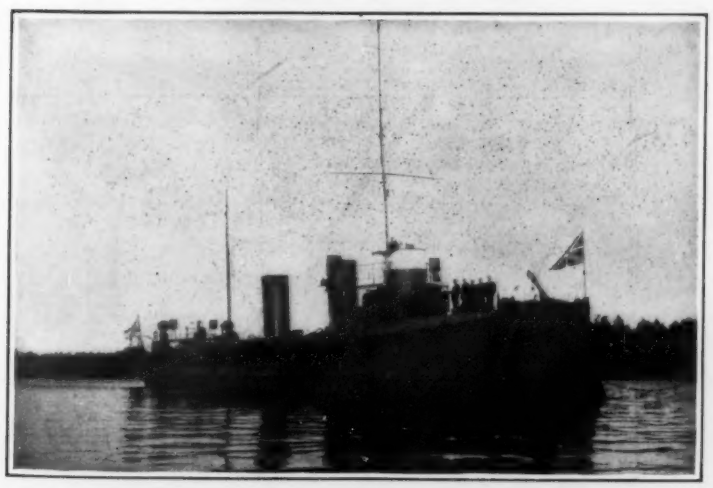
Date, 1905. **Tons,** 13,500. **Speed,** 18 knots. **Guns,** four 12-inch, twelve 6-inch. **Torpedo tubes,** 4. **Side armor,** 7¾-inch.

Pre-dreadnoughts: "Slava"; "Tsarevitch."



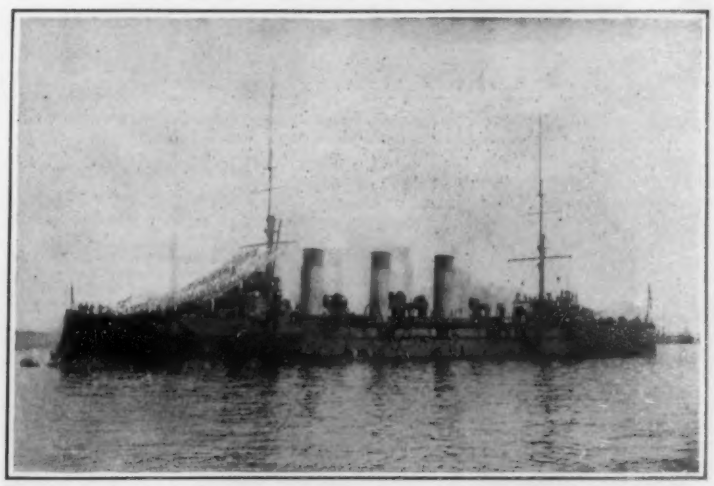
Date, 1907. **Tons,** 7,700. **Speed,** 22.5 knots. **Guns,** two 8-inch, eight 6-inch. **Torpedo tubes,** 2. **Side armor,** 7-inch—3¼-inch.

Armored cruisers: "Admiral Makaroff"; "Pallada"; "Bayan."



Date, 1905. **Tons,** 625. **Speed,** 26 knots. **Guns,** two 3-inch, six 6-pounders. **Torpedo tubes,** 3.

Torpedo-boat destroyers: "Kondratenko"; "Okhotnik"; "Pogranitschnik"; "Siberskij-Strelok."



Date, 1902-04. **Tons,** 6,675. **Speed,** 23-24 knots. **Guns,** twelve 6-inch, twelve 3-inch. **Torpedo tubes,** 4. **Armor,** 3-inch deck.

Protected cruisers: "Olej"; "Bogatyr."

Photos by Symonds & Co.

Germany's Bid for Naval Supremacy

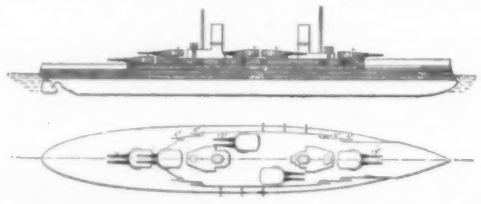
How the Kiel Canal Splits the British Fighting Line

A division of German dreadnoughts, "Westphalen" in the van.

As we have shown elsewhere in the present issue, any estimate of the strength of the German fleet, whether for offense or defense, must take into consideration the enormous strategic advantage to Germany of the Kiel Canal. It is a well-accepted principle of naval strategy, that a fleet should never be divided except in cases of urgent necessity; and it is the working of this principle in connection with this famous waterway which runs from Kiel in the Baltic to the mouth of the Elbe on the North Sea, which goes far to offset the numerical superiority of the British fleet, which at the present writing holds the Germans on the defensive in the Baltic.

In the absence of any reports to the contrary, it is reasonable to suppose that the dreadnought and pre-dreadnought fleets constituting Germany's first and second fighting line are gathered in the Baltic under the command of Admiral von Tirpitz. Also, it is probable that the four British battle-cruisers of the "Inflexible" type, which were in the Mediterranean at the opening of the war, have been withdrawn to the North Sea—this for the reason that the French fleet has a sufficient preponderance of strength to contain the Austrian fleet in the Adriatic. If the "Inflexibles" are in the North Sea, the first fighting line of the German navy, consisting of 16 dreadnoughts (the "Goeben" having been driven into the Dardanelles) finds itself opposed by a British first fighting line of 31 dreadnoughts, an inferiority of one to two. In the second fighting line, consisting of pre-dreadnoughts, Germany can oppose 20 ships to Great Britain's 40.

Now it is evident that for the Germans to come out and give battle in the North Sea, even if we allow for the chances of war, would be suicide; for although in a general engagement she could do terrible damage to the British fleet, the result could have no bearing upon the issues of war, and such damage as was done would be at the cost of the wiping out of the German navy.



Date, 1912. **Tons,** 24,300. **Speed,** 21.5 knots. **Guns,** ten 12-inch, fourteen 6-inch. **Torpedo tubes,** 5. **Side armor,** 14-inch—7-inch.

Dreadnoughts: "Kaiser"; "Friederich der Grosse"; "Kaiserin"; "Prinz Regent Luitpold"; "Konig Albert."

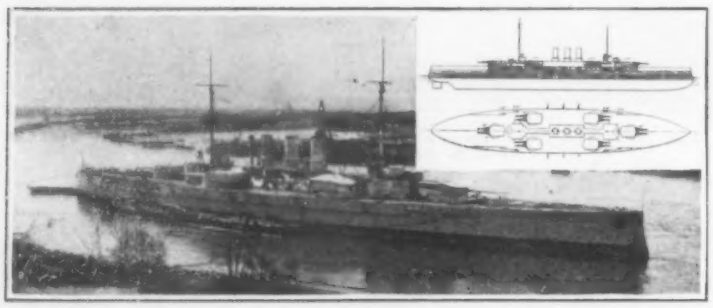
On the other hand, so long as Germany holds the Baltic, with a means of quick passage to the North Sea by the Kiel Canal, she can never be attacked by the whole of the British fleet; for if Sir John Jellicoe decided to force the Danish straits and seek out and engage the German fleet, he would have to leave at least half of his first fighting line at the mouth of the Elbe, or else expose the blockading fleet at that point to the risk of being encountered by the Germans in superior force.

Meanwhile, Germany, having the control of the Baltic, can prevent any landing of an expeditionary force upon her northern borders, and she is in a position, moreover, to accomplish the destruction of the Russian fleet and the bombardment of her ports and harbors.

The pride of the German navy is her fleet of dreadnoughts, and if this were lost, the remnants of her battleship fleet, because of the comparatively low power of the guns of its main armament, would be unable to give battle with much hope of success, even against a pre-dreadnought line of the same date of construction.

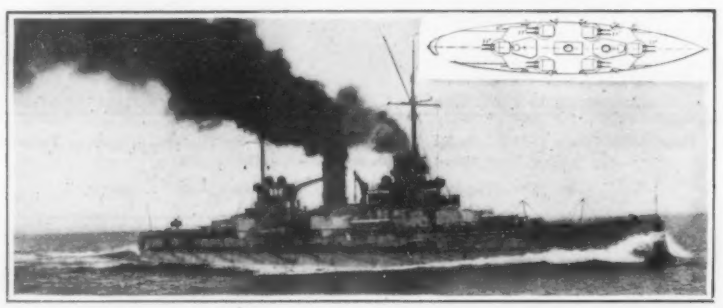
The original British dreadnought was built in 1905, and in 1906-07, Germany laid down her first four dreadnoughts of the "Nassau" class, of 18,600 tons and 20.5 knots, protected by 11¼-inch side armor and carrying a battery of twelve 11-inch and twelve 6-inch guns. In the arming of these ships, the Germans made two very serious mistakes. First, they mounted an 11-inch gun when the other powers were mounting the 12-inch, and secondly, they placed two of the turrets on each beam, with the result that in a broadside engagement four of the 11-inch guns are out of action, being masked by the opposite turrets on the engaged side.

In the four ships of the "Thuringen" class, completed in 1911-12, the mistake made in the "Nassau" class was partly rectified. The comparatively weak 45-caliber 11-inch piece gave way to a 50-caliber 12-inch piece of vastly greater power and efficiency, especially at long ranges. The displacement of these ships is 22,000 tons, and the speed 21.5 knots. They are protected by 11½ inches of side armor.



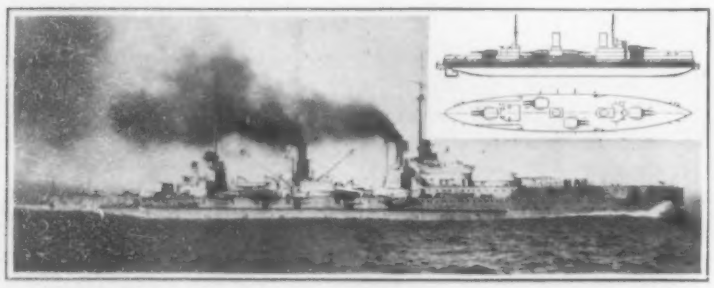
Date, 1911-12. **Tons,** 22,000. **Speed,** 21.5 knots. **Guns,** twelve 12-inch, fourteen 6-inch. **Torpedo tubes,** 6. **Side armor,** 11½-inch—6¼-inch.

Dreadnoughts: "Thuringen"; "Helgoland"; "Ostfriesland"; "Oldenberg."



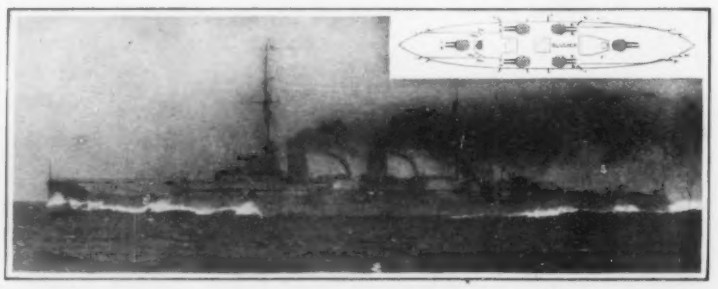
Date, 1909-10. **Tons,** 18,600. **Speed,** 20.5 knots. **Guns,** twelve 11-inch, twelve 6-inch. **Torpedo tubes,** 6. **Side armor,** 11½-inch—7-inch.

Dreadnoughts: "Westfalen"; "Nassau"; "Posen"; "Rheinland."



Date, 1911. **Tons,** 18,700. **Speed,** 27.5 knots. **Guns,** eight 11-inch, ten 6-inch. **Torpedo tubes,** 4. **Side armor,** 10-inch—4½-inch.

Battle-cruiser: "Von der Tann."

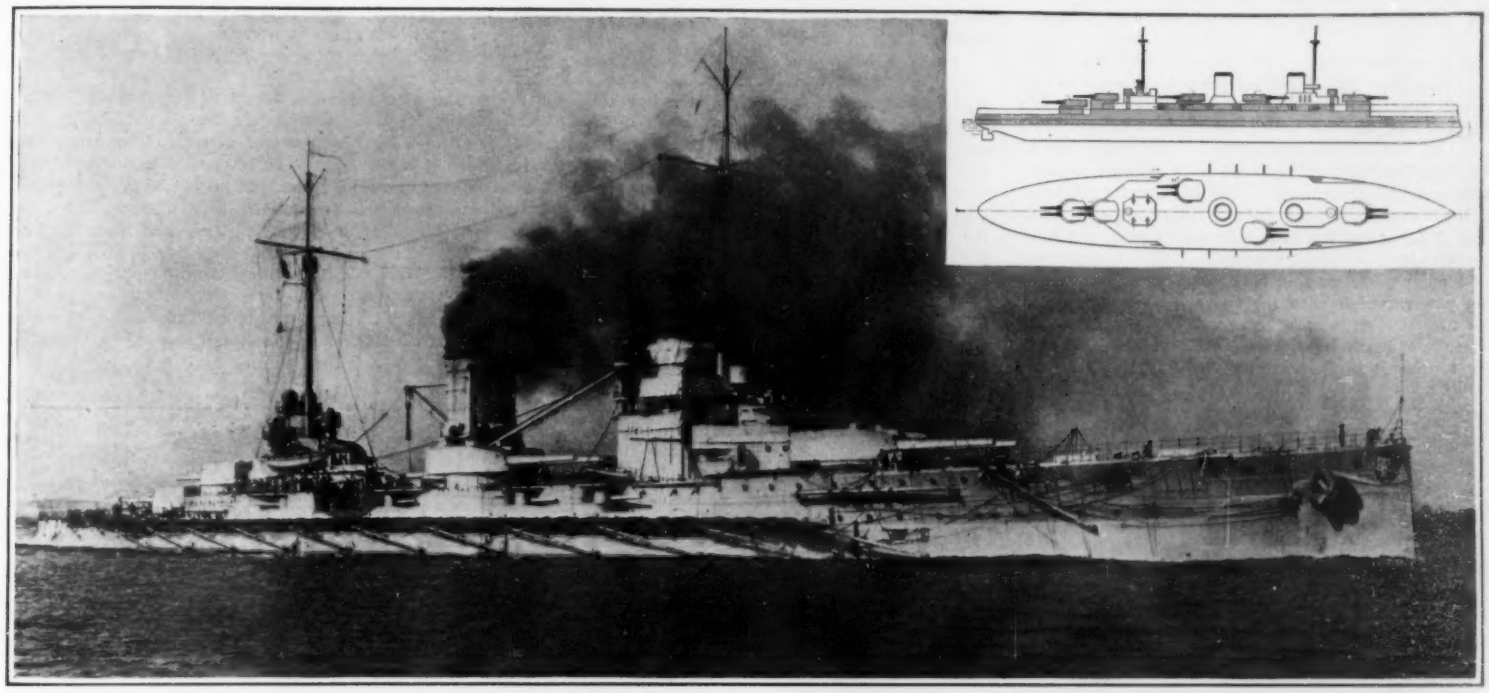


Date, 1909. **Tons,** 15,500. **Speed,** 26 knots. **Guns,** twelve 8.2-inch, eight 6-inch. **Torpedo tubes,** 3. **Side armor,** 6-inch.

Armored cruiser: "Blucher."

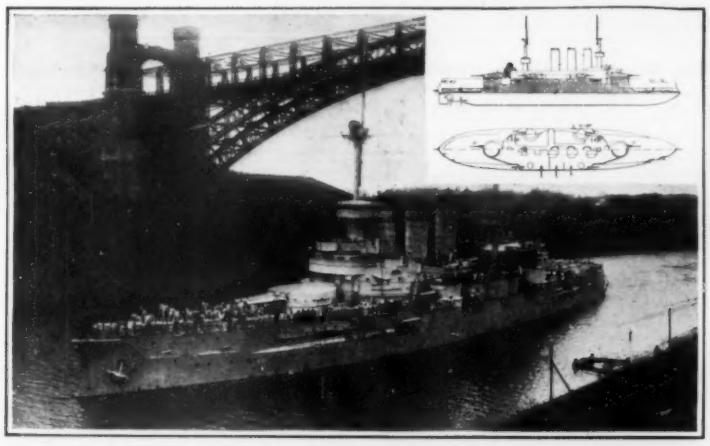
Photos by A. Renard.

For reasons best known to themselves, the German ordnance officers, or whoever is responsible for the disposition of the armament, deliberately sacrificed a third of the effectiveness of the broadside of the "Thuringen" class, by retaining the quadrilateral arrangement of turrets that exists in the "Nassau" class. The Germans are great theorists; but in this case the theory of the value of a head-on attack, in which the ship can concentrate a fire of six guns, led them in the wrong direction. There is a consensus of opinion among naval men that no wise admiral will expose his ships to the danger of being raked in the end-on position by the 12- and 14-inch guns of the enemy. Future battleship engagements will be fought broadside to broadside, at ranges of from 9,000 to 11,000 yards.



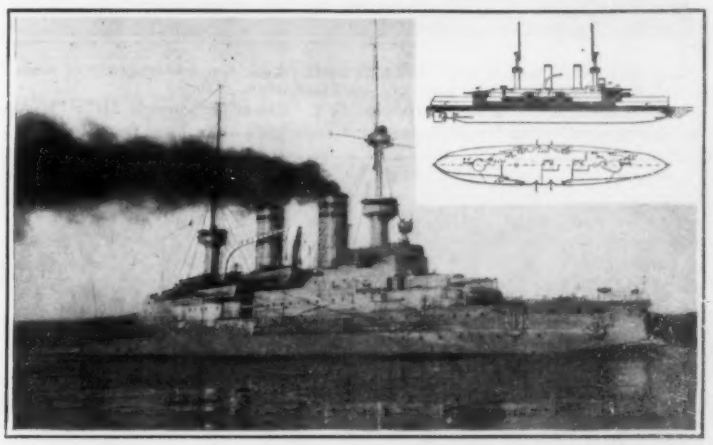
Date, 1911-13. **Tons,** 23,000-25,000. **Speed,** 28 knots. **Guns,** ten 11-inch, twelve 6-inch. **Torpedo tubes,** 4. **Side Armor,** 11-inch—4-inch.

Battle-cruisers: "Moltke"; "Seydlitz." ("Goeben," driven to the Dardanelles; sold to Turkey.)



Date, 1904-08. **Tons,** 13,000. **Speed,** 20 knots. **Guns,** four 11-inch, fourteen 6.7-inch. **Torpedo tubes,** 6. **Side armor,** 9-inch—6-inch.

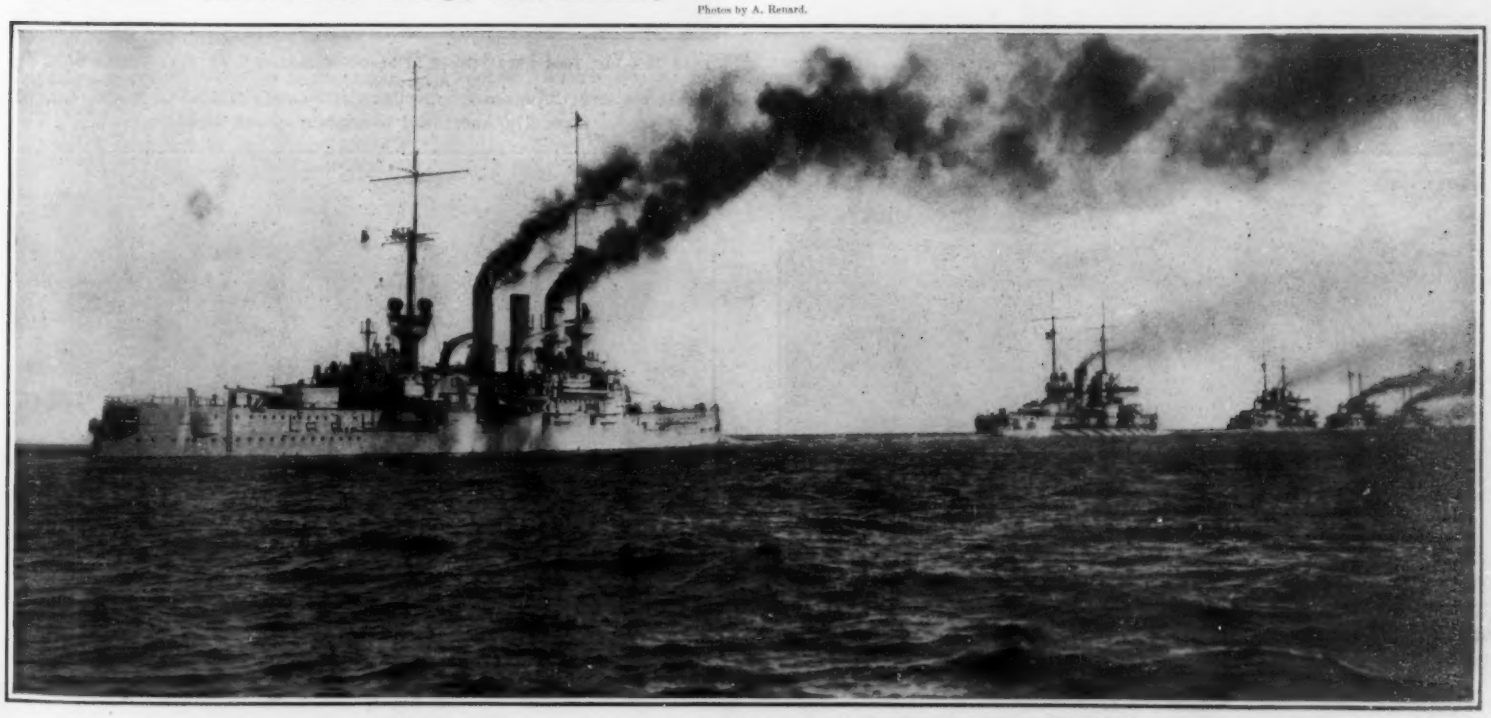
Pre-dreadnoughts: "Braunschweig"; "Elsass"; "Lothringen"; "Hessen"; "Preussen"; "Deutschland"; "Hannover"; "Pommern"; "Schleswig-Holstein"; "Schlesien." (This view shows "Lothringen" in the Kiel Canal.)



Date, 1902-03. **Tons,** 11,600. **Speed,** 18-19 knots. **Guns,** four 9.4-inch, eighteen 6-inch. **Torpedo tubes,** 6. **Side armor,** 9-inch.

Pre-dreadnoughts: "Mecklenburg"; "Wittelsbach"; "Schwaben"; "Wettin"; "Zahringen."

Photos by A. Renard.



Pre-dreadnought "Hannover" (left) preceded by dreadnoughts of the "Nassau" class.

In the five ships of the "Kaiser" class, completed in 1912-13, the Germans rectified their mistake by placing three of the turrets on the center line and the other two diagonally on the broadside, thereby enabling the whole of the battery to train on either beam. This is a better, but not the best, arrangement since the midship turrets mask each other throughout a considerable arc of fire.

In their four ships of the "Grosser Kurfurst" type, which are due for completion toward the close of the present year, the Germans have followed the principle (inaugurated by the naval constructors of our own navy) of placing all the turrets on the center line of the ships. The "Kaiser" class are of 24,700 tons displacement and 21.5 knots speed. They are heavily protected with side armor ranging from 14 to 7 inches in thickness. They mount ten 12-inch 50-caliber guns, and fourteen 6-inch.

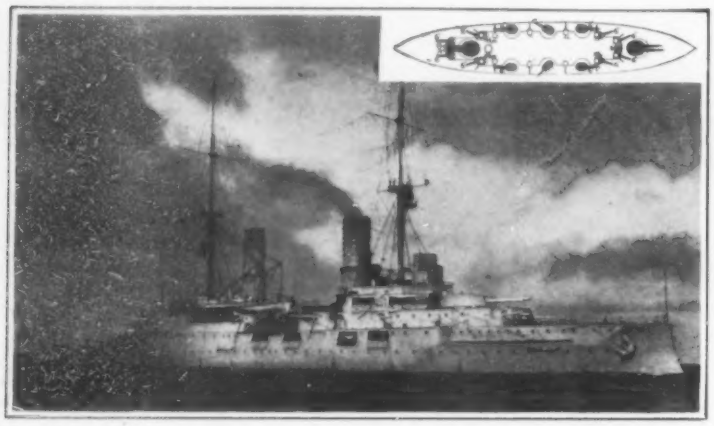
Germany possesses four battle-cruisers of great speed and power, which have the enormous advantage over the armored cruisers of other navies that the side armor is of battleship thickness. This means that they can be placed in the first fighting line, and take the blow of the heaviest projectiles of the enemy, with the expectation of no greater chance of disablement than the battleship. In this the Germans have shown great forethought, and it must be admitted that this superiority in protection largely offsets the fact that their main armament of 11-inch guns is much weaker than the armament of 12's and 13.5's mounted on the battle-cruisers of the British navy.

The "Von der Tann," completed in 1910, of 18,700 tons displacement and 28 knots speed, has 10 inches of side armor, and mounts eight 11-inch 45-caliber guns in turrets. The "Moltke," completed in 1911, of 23,000 tons and 28 knots speed, is protected with 11 inches of side armor, and carries ten 50-caliber 11-inch guns in turrets. The "Seydlitz," of 25,000 tons, has made 29 knots. She has the same protection and armament as the "Moltke." All of these ships carry powerful torpedo defense batteries of 6-inch guns.

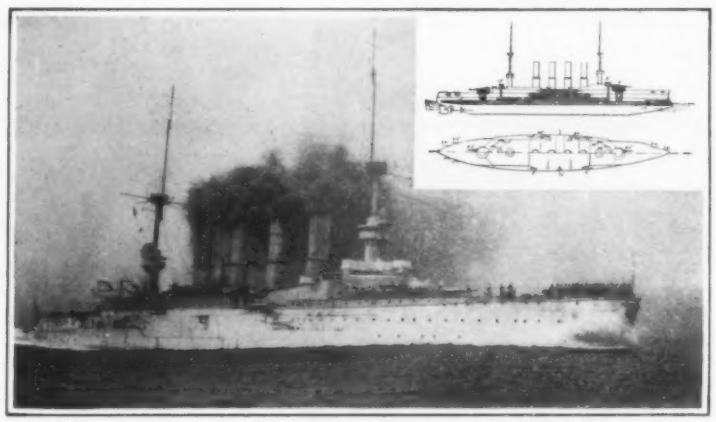
The pre-dreadnoughts of the German navy, 20 in number, were built in classes of 5 each, and all of them suffer from the defect of carrying too light a gun in their main batteries. Thus the 10 ships of the "Kaiser Wilhelm II" and "Wittelsbach" classes carry as their main battery four 9.4-inch 40-caliber guns—a piece which would be wofully ineffective at the great ranges at which modern engagements will be fought. In the "Braunschweig" class of 5 ships, the main battery consists of four 11-inch guns of 40 calibers, and the same thing is true of the 5 ships of the "Deutschland" class. The remaining energies, even of these 11-inch guns, at a range of 10,000 yards would not be sufficient to effect the penetration of battleship armor.

The nine armored cruisers of the German fleet are headed by the "Blucher," a fine ship of 15,500 tons, protected by 6-inch armor and mounting twelve 8.2-inch 45-caliber guns in turrets and a broadside of eight 6-inch guns. Her speed is 26 knots. The "Scharnhorst" and "Gneisenau," completed in 1907, are of 11,500 tons and 23 to 24 knots speed. They are protected by 6 inches of armor and carry eight 8.2-inch 40-caliber guns and six 6-inch. The "Roon" and "Yorck," completed in 1905-1906, are 9,050 tons displacement, are protected by a 4-inch belt, and carry four 8.2-inch 40-caliber guns in turrets and ten 6-inch 40-caliber guns on the broad-

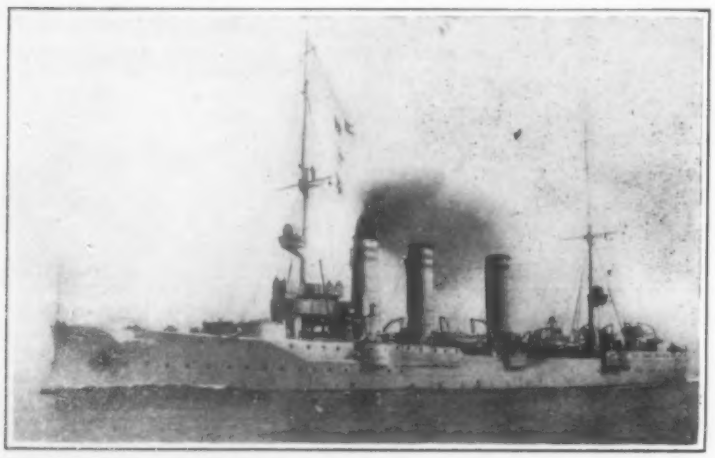
(Concluded on page 199.)



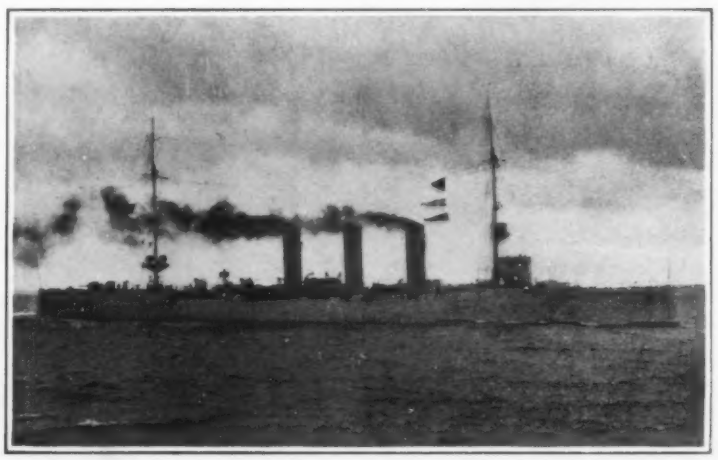
Date, 1898-1901. **Tons,** 10,800. **Speed,** 18 knots. **Guns,** four 9.4-inch, eighteen 6-inch. **Torpedo tubes,** 6. **Side armor,** 9-inch—6-inch.
Pre-dreadnoughts: "Kaiser Wilhelm II"; "Kaiser Friederich III"; "Kaiser Barbarossa"; "Kaiser Wilhelm der Grosse"; "Kaiser Karl der Grosse."



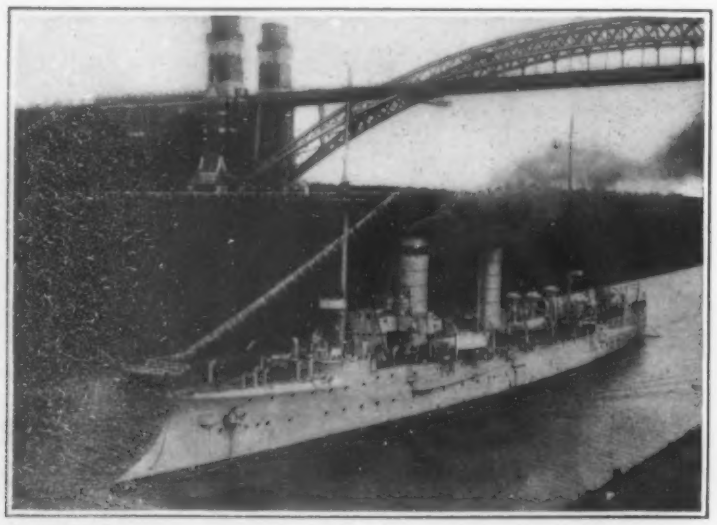
Date, 1908. **Tons,** 11,500. **Speed,** 22.5-23.5 knots. **Guns,** eight 8.2-inch six 6-inch. **Torpedo tubes,** 4. **Side armor,** 6-inch—5-inch.
Armored cruisers: "Scharnhorst"; "Gneisenau."



Date, 1908. **Tons,** 3,450. **Speed,** 23.7-24 knots. **Guns,** ten 4.1-inch. **Torpedo tubes.** 2. **Armored deck,** 2-inch.
Protected cruisers: "Stettin"; "Stuttgart"; "Nurnberg."



Date, 1909-10. **Tons.** 4,350. **Speed,** 27 knots. **Guns,** twelve 4.1-inch. **Torpedo tubes,** 2. **Armored deck,** 2-inch.
Scout cruisers: "Augsburg"; "Kolberg"; "Mainz"; "Köln." Also "Breslau" class, 27.5 knots, and "Karlsruhe" class, 28 knots.



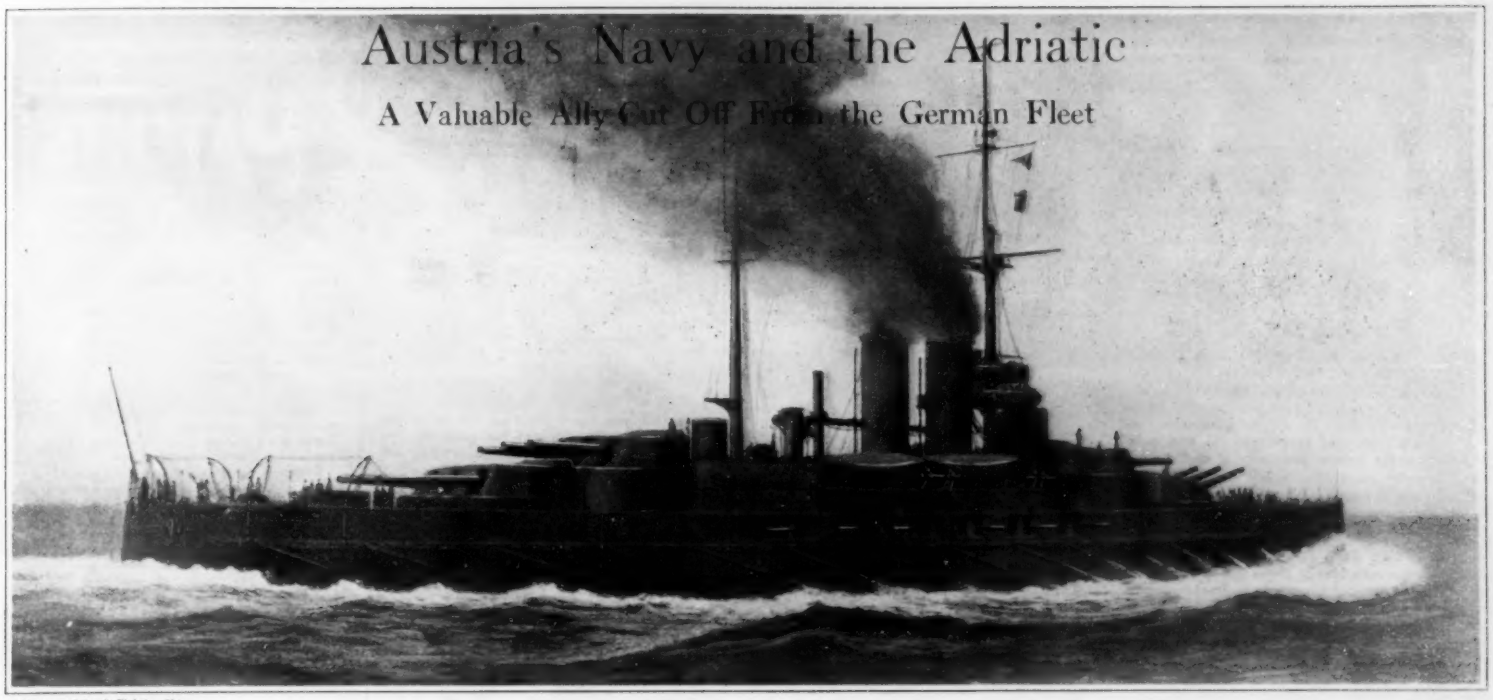
Date, 1903. **Tons,** 2,715. **Speed,** 21.5 knots. **Guns,** ten 4.1-inch. **Torpedo tubes,** 2. **Armored deck,** 2-inch.
Protected cruisers: "Arcona";* "Frauenlob"; "Undine."
*The "Arcona" is here seen passing through the famous Kiel Canal.

Date, 1909. **Tons,** 650. **Speed,** 32.5 knots. **Guns,** two 24-pounders. **Torpedo tubes,** 3.
Group of destroyers maneuvering at full speed.

Photos by A. Renard.

Austria's Navy and the Adriatic

A Valuable Ally Cut Off From the German Fleet

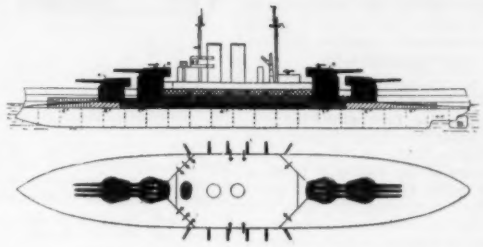


Courtesy of Jane's Fighting Ships.

ALTHOUGH the strategical situation of the present war, as affected by the geography of the countries concerned, is standing Germany in good stead, as we have shown in a previous chapter, it also hits her very hard in cutting off entirely from any close co-operation the efficient little fleet of Austria in the Adriatic. Immediately upon the declaration of war, the French fleet closed in on the Adriatic; and the probability is that at the present time the Austrian fleet is at the northern end of that gulf, closely blockaded by a French fleet of greatly superior power. If the Austrian fleet has retreated to Port Pola, it is secure in a land-locked harbor, on either side of the entrance of which are heavy modern coast defenses. Pola is a dock-yard with two fixed drydocks and a floating dock; and judging from the frequency with which this place has been mentioned in the war dispatches, it is not unlikely that the Austrian fleet is gathered there.

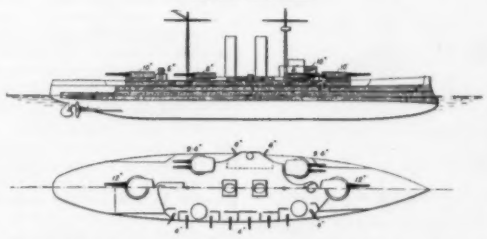
The most valuable asset of the Austrian fleet is the pre-dreadnoughts of the "Viribus Unitis" class, and the three semi-dreadnoughts of the "Franz Ferdinand" class, all six vessels being of thoroughly modern construction, heavily armed and well-protected.

The "Viribus Unitis" was one of the first dreadnoughts to adopt the three-gun turret. It is significant of the great capacity for gun-mounting afforded by this triple arrangement, that, on the modest displacement of 20,000 tons, the "Viribus Unitis" and her sisters mount no less than twelve 12-inch guns apiece. The four turrets are disposed on what has come to be known as the "Michigan" plan; there being two turrets forward, the guns of the after turret firing above the roof of the fore turret, and two turrets aft having a similar arrangement for gun fire. The advantage of this arrangement is that every gun can be trained through a wide arc of broadside fire, and that there is a possible concentration of guns, dead ahead or dead astern of six 12-inch pieces. The ships, despite their heavy battery, are well protected, carrying side armor of 11-inch thickness at the water-line, above which, between turrets 2 and 3, is side armor of 8 inches thickness, while above this, covering the 6-inch battery, is 6 inches of armor. The speed is 20.7 knots, and each ship carries four torpedo tubes.



Date, 1913-14. **Tons,** 20,000. **Speed,** 20.7 knots. **Guns:** twelve 12-inch, twelve 6-inch. **Torpedo tubes,** 4. **Side armor,** 11-inch—8-inch—6-inch.

Dreadnoughts: "Viribus Unitis"; "Tegetthoff"; "Svent Istvan."



Date, 1910-11. **Tons,** 14,300. **Speed,** 20.5 knots. **Guns:** four 12-inch, eight 9.4-inch, twenty 4-inch. **Torpedo tubes,** 3. **Side armor,** 9-inch.

Semi-dreadnoughts: "Erzherzog Franz Ferdinand"; "Radetzky"; "Zrinyi."

Austria possesses three semi-dreadnoughts of 14,500 tons, 20.5 knots speed, protected by side armor whose thickness from the water-line up is, respectively, 9 inches, 6 inches, and 3 inches; and each of them carries three torpedo tubes. The battery is heavy, consisting of four 12-inch, and eight 9.4-inch guns all mounted in turrets. For torpedo defense, each ship carries twenty 4-inch 50-caliber guns.

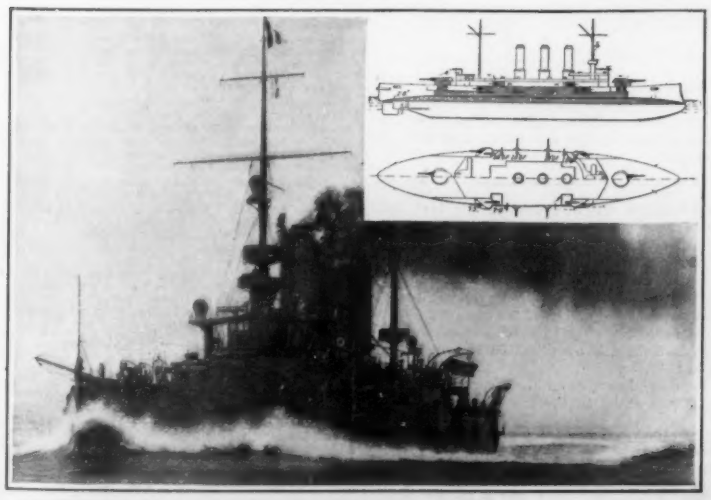
Of pre-dreadnoughts of battleship size, Austria possesses three of the "Ferdinand Max" type. These would have been more effective ships if the Austrians, influenced no doubt by German practice, had not mounted the 9.4-inch 40-caliber gun as their main armament. Of these the "Ferdinand Max" and class carry each four in two turrets, and there is a heavy broadside battery of twelve 7.6-inch guns. These vessels are of 10,500 tons and 20.5 knots speed. The side armor is from 8¼ to 6 inches.

Important vessels for coast defense are the six ships of the "Hapsburg" and "Wien" classes, the "Hapsburg" of 8,340 tons and 19.5 knots speed, mounts three 9.4-inch guns in turrets and twelve 6's in casemates. The armor is 8¾ inches. The "Hapsburg" class was completed in 1903-04. The "Wien" class carry four 9.4-inch and a battery of six 6-inch on a displacement of 5,600 tons. They were built in 1895 to 1896, and are protected by a 10½-inch belt of armor.

Austria possesses two modern armored cruisers: "Sankt George," 7,400 tons, 22 knots, mounting two 9.4's and five 7.6's; and "Kaiser Karl VI," 6,300 tons and 20 knots, carrying two 9.4's and eight 6's. Smaller and older vessels are the "Kaiserin Theresia" and the "Kaiserin Elizabeth," of 5,200 and 4,000 tons displacement, and 17½ and 19 knots speed, respectively. The "Theresia" carries two 7.6-inch and eight 6-inch guns and the "Elizabeth" six 6-inch guns.

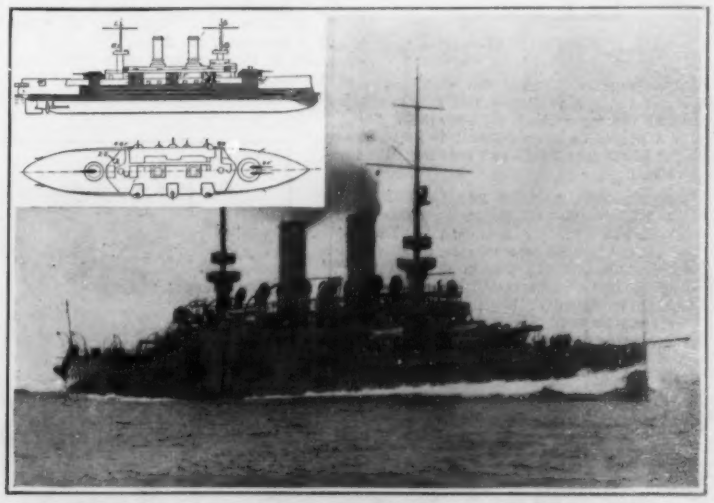
Of the protective cruisers the most valuable are the four fast scouts, "Saida," "Helgoland," Novara," and "Admiral Spaun." They are of 3,500 tons and 27 knots speed, and mount a battery of 4.1-inch guns.

Next to her dreadnoughts and semi-dreadnoughts, the most valuable vessels of the Austrian fleet are her 18 destroyers, 39 torpedo boats, and 6 submarines. The destroyers are from 400 to 800 tons and from 28 to 32 knots speed, and the torpedo boats run in displacement from 110 to 250 tons and in speed from 26 to 38 knots.



Date, 1905-07. **Tons,** 10,500. **Speed,** 20-20.5 knots. **Guns,** four 9.4-inch, twelve 7.5-inch. **Torpedo tubes,** 2. **Side armor,** 8¼-inch.

Pre-dreadnoughts: "Erzherzog Ferdinand Max"; "Erzherzog Karl"; "Erzherzog Freidrich."



Date, 1903-04. **Tons,** 8,340. **Speed,**19.5 knots. **Guns,** three 9.4-inch, twelve 6-inch. **Torpedo tubes,** 2. **Side armor,** 8¾-inch—5-inch.

Pre-dreadnoughts: "Hapsburg"; "Arpad"; "Babenberg."

Photos by F. W. Behrinner.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Of Interest to Farmers.

POTATO SORTER.—E. HELLFACH, Wahalla, N. D. This improvement refers to machines for sorting and grading fruits and vegetables, and the main object thereof is to provide such a machine which automatically performs such operation without injury to the articles being graded, and which delivers the same at different points, according to grade.

Of General Interest.

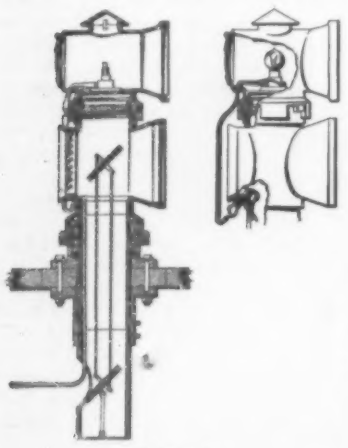
PROCESS FOR PRODUCING MOLDS FOR CASTING STEREOTYPE PLATES.—C. WINKLER, Berne, Switzerland. Hot gases, hot air, or a hot liquid may be introduced into hollow chambers provided in the mold during the turning operation in this invention. If the mold has no special hollow chambers a heating device may be employed, which can have any suitable construction, and may consist, for example, of pipes containing some hot agent and brought into contact with the mold.

CIGARETTE BOX.—A. MENDELSON and S. J. GOLDBERG, 482 Marcy Ave., Brooklyn, N. Y. In this instance the invention has reference to improvements in cigarette boxes or boxes for dispensing cigarettes or similar articles, in which it is essential that such articles be spaced apart to be readily grasped and withdrawn with convenience and without being mutilated.

SANITARY DENTAL IMPRESSION TRAY.—G. L. GRIER. Address the L. D. Caulk Co., Milford, Del. This inventor provides a device having a body portion and a handle therefor with novel means for detachably securing the body portion to the handle. He also provides a dental tray handle capable of being secured to trays of different sizes without necessitating any adjustment of the handle itself.

VAPOR CONDENSER.—G. M. HILGER, 1540 W. 62nd St., Chicago, Ill. This invention provides a condenser constructed and arranged to cause the liquid vapor to travel in a current or direction counter to the flow of a cooling liquid; provides means for separating the condensed vapors from contained gases; and provides means whereby the products of condensation are conveyed out of the path of the flowing gas, to avoid being carried over by suspension therein.

PERISCOPE.—J. HANSON, Inverness, Skeena River, B. C., Canada. This invention provides a periscope which forms, also, a ventilator and a skylight, and is adapted to carry a projecting lamp coacting with the periscope. This is obtained by providing a rotatable turret having therein a pair of coacting, turnable, reflecting mirrors forming the periscope, said turret forming a ventilator, and also having a lens at the top thereof, forming the skylight, and a projecting lamp adapted to engage the turret above said lamps and coacting with the mirrors.



PERISCOPE.

ANTI-RATTLER AND SASH ADJUSTER FOR WINDOWS.—H. W. ILLENBERGER, care of A. D. Danziger, 204 Carondolet St., New Orleans, La. The purpose here is to provide a device which will also possess the capabilities of operating to hold a sash in an adjusted position when raised or lowered, in addition to preventing the sashes from rattling and causing the same to fit tightly in the guideways of the frame, in such a manner as to exclude draft and wind and the effects of inclement weather.

Heating and Lighting.

OIL BURNER.—A. D. MARCOTTE, care of Eunice Carriage and Machine Shop, Eunice, La. In the present invention the object is the provision of an improved device for burning crude or low-grade oil, so as to effect its complete combustion without production of soot or smoke, which are frequently incident to the burning of oils of this character.

Household Utilities.

COLANDER.—SARAH E. DE CREVECOEUR, 277 W. I St., Colton, Cal. This invention relates to culinary utensils, and particularly to what are known as colanders, and the object is to provide a structure which is designed to move fruit or other material transversely of a perforated straining member through which it is gradually forced, so as to more easily and uniformly distribute the straining.

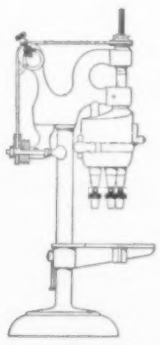
IMPROVED COLANDER.

Machines and Mechanical Devices.

GRAVEL MACHINE.—H. T. SYKES, New London, Mo. This machine removes sand or gravel from a pit or holder and deposits it on board cars or other receptacles, and is so arranged that the device will load and unload itself, and wherein a dumping door is provided, so arranged that it will automatically open when the machine reaches the dumping position, and automatically close as the machine returns to loading position.

VALVE.—N. B. CREIGHTON, Chicago St., Elmhurst, L. I., N. Y. This invention provides a valve for use in pipe lines conveying gas, liquids, or other fluids from place to place, and arranged to normally hold the valve in open position for passage of the fluid and to allow of releasing the valve from a distant point whenever it is desired to close the valve, and to permit the valve to close automatically in case of fire and to hold it locked in closed position.

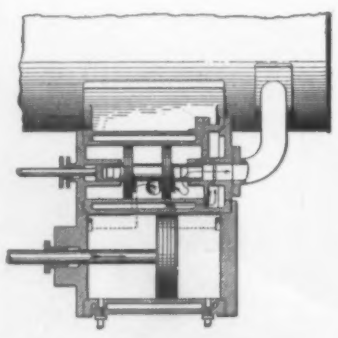
AUTOMATIC MULTIPLE-CHUCK DRILL-PRESS.—JOSEPH N. LANDAU, 101 West 117th St., New York, N. Y. The primary object of the invention is to provide an automatic multiple-chuck drill-press in which either of the chucks or tool-holding devices may be brought into successive coupling position to be rotated or operated from a single working spindle, the improvement being designed to be applied to machines which are now generally constructed, or to a machine having a specially mounted and driven spindle.



AUTOMATIC MULTIPLE-CHUCK DRILL-PRESS.

Prime Movers and Their Accessories.

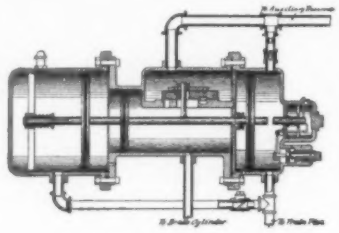
ENGINE CYLINDER.—A. W. GUSTAFSON, 115 Harrison Ave., Jersey City, N. J. The objects in this case are: to prevent loss of heat in the expansive medium employed by the engine; to automatically create and maintain a jacket of rarefied air surrounding the chambers containing the expansive medium; and to simplify the construction whereby these objects are obtained.



IMPROVED ENGINE CYLINDER.

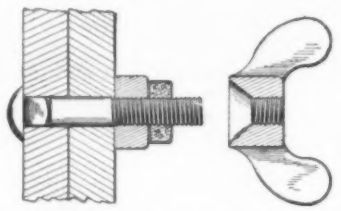
Railways and Their Accessories.

TRIPLE VALVE.—H. O. MARTIN, Box 273, Clovis, New Mex. This invention relates to fluid pressure brakes of the Westinghouse or similar types, and its object is to provide a valve arranged to utilize an equalizing pressure and the combined force of the train line and brake cylinder pressure for properly controlling the triple valve and preventing uneven pressures in the brake cylinder and to prevent undesired quick action application.



TRIPLE VALVE FOR AIR BRAKES.

NUT LOCK.—J. G. SCHNEIDER, York, Pa. This nut lock is particularly adapted for use in securing fish plates to railway rails, but, of course, is capable of general application. The jam of locking nut has a body formed of a soft elastic material such as cork, and an inclosing casing of thin sheet metal, both of which are compressed into conical form engaging the thread of the bolt to which the main nut is applied.



IMPROVED NUT LOCK.

Pertaining to Vehicles.

BICYCLE CRANK HANGER.—G. W. MCILWAINE, 114 Feronia Way, Rutherford, N. J. This invention provides a hanger adapted especially for repair work, although it may be used in connection with new devices. The hanger is well adapted to be applied to various sizes or makes of bicycle brackets without reconstruction except to cut off certain of the parts, according to the required length.

TRACTION ENGINE.—S. S. MORTON, care of the Herr Engine Co., Portsmouth, Ohio. The object of the invention is to so construct the tractor that the power will be distributed evenly to the driving wheels and that simplicity of operation will be obtained with a construction that is strong, yet flexible, as regards accommodating itself to inequalities of the ground.

Designs.

DESIGN FOR A POT AND COVER LIFTER.—K. PROCHASKA, Vienna, Austria-Hungary, care of Berthold Lehner, 25 W. Broadway, New York, N. Y. Views of this design, showing it in perspective, plan, and edge positions, present an article indicating strength, utility, and ornamental lines.

DESIGN FOR A FRUIT AND VEGETABLE KNIFE.—H. BOSWORTH, care of W. G. Bosworth, 192 Broadway, New York, N. Y. This ornamental design for a knife in side view shows a flat, thin blade, one third of its length considerably narrowed in its height, and the edge view showing a straight blade turned up at its end. The handle is of graceful form.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Inquiry No. 9378. Wanted the name and address of a manufacturer of smooth metal mirror frames, such as are sold in 5 and 10 cent stores, with a mirror and a cardboard back.

Inquiry No. 9379. Wanted meteorites—information desired concerning available specimens.

Inquiry No. 9380. Wanted the name and address of a manufacturer of burners and handles for gas-heated sad iron.

Inquiry No. 9381. Wanted the name and address of manufacturers of vacuum adhesive hangers or other appliances for hanging cards, frames, charts, etc., to walls of buildings.

Inquiry No. 9382. Wanted the name and address of a manufacturer who can make a small or large quantity of sugar bowls with trade marks incorporated therein.

Inquiry No. 9383. Wanted the name and address of a manufacturer who can make clock movements suitable for fly trap. They must be furnished at low cost and must operate a belt for a period of from two to four hours, or more.

Inquiry No. 9384. Wanted the name and address of a Company that can manufacture a combined toothpick and toothbrush made of special wood.

Inquiry No. 9385. Wanted the names and addresses of manufacturers of machines used for perforating music rolls for automatic pianos.

Inquiry No. 9386. Wanted a device to prevent eavesdropping on party telephone line.

Inquiry No. 9387. Wanted the name and address of manufacturer of composition roofing for tops of freight cars that will stand reasonable wear and tear, and for extreme wet weather and hot tropical climate.

Inquiry No. 9388. Wanted the name and addresses of manufacturers of a fiber board, which is absolutely smooth on both sides, not subject to warping and free from any imperfections such as ridges or small irregularities. Board should come to about 5 ft. wide by 5½ ft. long, and run from ⅛ to ¼ of an inch in thickness, and must be reasonably economical. A board of hard rubber would be exactly what was required, only the expense is too prohibitive to make its use practical.

Inquiry No. 9389. Wanted the name and address of manufacturers of valves, cylinders, recording gages, filling and weighing stands and all material and appliances which enter into the manufacture, transportation and sale of compressed gases.

Inquiry No. 9390. A syndicate of gentlemen desire to get in touch with an inventor or manufacturer of some small patented article with a view of placing the same on the market. Large capital and expert sales force if the invention or article stands examination. Automobile specialties preferred.

Inquiry No. 9391. Wanted the name and address of makers of plants for the utilization of by-products from sawdust, also waste wood.

WESTINGHOUSE ELECTRIC

Westinghouse Electric

Motor Drive Gives Your Plant the Elasticity to Meet Every Manufacturing Condition

NOW that the world is looking to American manufacturers to supply its needs in many varieties of finished goods—the manufacturer who has the modern factory and equipment will be in position to grasp his opportunity.

With old fashioned machinery for operating his plant, the manufacturer, already running up to capacity, with a similar chance and the ambition to improve it would have to build a complete new plant.

The manufacturer whose plant is equipped with Westinghouse Motor drive has merely to add new machines and new motors as the business grows.

There is no questioning the economy of the Westinghouse method. Westinghouse motors are designed to give the most efficient service for the machine or group of machines on which they are to be used. They consume power in exact proportion to the work they are called upon to do.

They are built for long life. At the rate the manufacturer usually writes off his machinery for depreciation, the Westinghouse Motor is paid for long before there is a suspicion of actual depreciation in its work or ability to work.

There is service value as well as physical value in Westinghouse Motors. When you purchase equipment upon which is the Westinghouse name, you also get the full benefit of the Westinghouse organization's long experience. In other words, you automatically bring into your own business one of the most famous of the world's engineering bodies.

Before you even start to plan, talk to a Westinghouse Electric man.

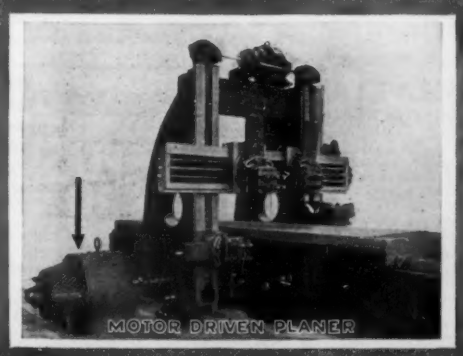
Address Department B-J.

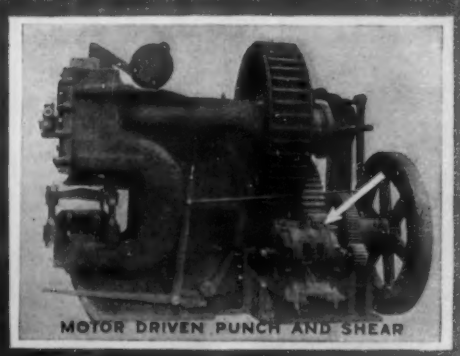
Westinghouse Electric & Manufacturing Co.

East Pittsburgh, Penna.

Sales Offices in 45 American Cities

Representatives all over the World





Tarvia
Preserves Roads Prevents Dust

Tarvia Road, Middletown, R. I.

How to reduce your road taxes—

THE modern way to build macadam roads is to bond them with Tarvia, a dense, viscid, coal tar binder. It adds a little to the first cost of the road, but it saves a lot in the annual maintenance charges.

A Tarvia-bonded road will keep its contour for many years. It will shed water. Automobile traffic does not tear it to pieces. It produces little or no dust. It does not ravel on grades, for the waterproof character of Tarvia prevents such damage.

After a hard winter the snow melts from the tarviated road and reveals the surface in good condition.

Tarvia has won its way among up-to-date engineers simply on the basis of the money which it saves. Town after town has learned that it can reduce the cost of its highways by the steady extension of Tarvia treatment.

The art of road building has now reached a point where the dusty road is in itself proof that the road is wasting the taxpayers' money, because it cannot withstand modern traffic.

Booklets on request.

BARRETT MANUFACTURING COMPANY
New York Chicago Philadelphia Boston St. Louis Cleveland Cincinnati Pittsburgh Birmingham Kansas City Minneapolis Seattle

THE PATERSON MFG. CO., Limited: Montreal Toronto Winnipeg Vancouver St. John, N. B. Halifax, N. S. Sydney, N. S.

Interstate Insurance Solved by Postal Life

Receives business from every State—*direct*

THERE are 260 legal reserve life-insurance companies in the country, all operating through agents, yet only 33 of these companies do business in the State of New York.

Similarly, of the largest four New York companies—"the giants," so-called—**not one does business in Texas; two of them do not enter Wisconsin, and the fourth does no business in ten States.**

The States will not let agents solicit business unless their companies take out licenses, pay so-called "occupation" taxes, and submit to other State exactions, which some companies can not, or will not, do.

The Postal Life, a New York company, complying with all the strict requirements of that State, is the only insurance institution that receives business from *every State in the Union*, thus enabling everyone to arrange insurance direct.

The POSTAL is, in quite a true sense, **an interstate institution**, and it can transact an interstate business, **because it is a non-agency company**; it employs no agents and does not send them into the various States.

It is therefore exempt from the various expensive requirements applicable to companies employing agents and agencies. *Postal policy holders get the benefit.*

Pays claims in every State—*promptly*

THE one who wants insurance in the Postal Life **writes**, as a citizen of the United States, **direct** to the Company's New York headquarters—in its Home Office Building shown above—**its only place of business.** The Postal answers by mail, employing the usual Government facilities, and it is thus subject to the United States Postal authorities—also to the Federal Courts.

Uncle Sam brings letters from applicants, wherever they live, and takes the Company's answers wherever they are directed.

Insurance is thus arranged and policy-claims are paid by check mailed *direct* to the beneficiary—and *promptly*.

STRONG POSTAL POINTS

First: *Old-line legal-reserve insurance*—not fraternal or assessment.

Second: *Standard policy reserves*, now more than $9,000,000. *Insurance in force*, more than $45,000,000.

Third: *Standard policy provisions*, approved by the State Insurance Department.

Fourth: Operates under *strict State requirements* and subject to the United States postal authorities.

Fifth: *High medical standards* in the selection of risks.

Sixth: *Policyholders' Health Bureau* arranges one free medical examination each year, if desired.

See How Easy It Is

In writing simply say: *Mail me insurance particulars for my age as per the* Scientific American for September 5th.

In your letter be sure to give:

1. *Your Full Name.*
2. *Your Occupation.*
3. *The Exact Date of your Birth.*

No agent will be sent to visit you: the Postal Life dispenses with agents; **you** get the benefits of the agent's commission because you deal **direct**.

Postal Life Insurance Company

Wm. R. Malone, President

35 Nassau Street New York

Net Cost Low in the POSTAL because

1st. Commission Dividends corresponding to agent's commissions, less the moderate advertising charge, go to Postal Policyholders the first year.

2d. Renewal-Commission Dividends and **Office expense Savings**, covered by the

9½%

guaranteed dividends, go to Policyholders in **subsequent years.**

3d. Beginning at the close of the second year, **Contingent Policy Dividends**, based on the company's earnings, still further reduce the cost each year after the first.

ROOFS ABOVE CEILINGS
HY-RIB EVERYWHERE
In any type of structure HY-RIB assures permanent concrete construction, quickly erected at low cost. HY-RIB eliminates forms, studs and channels in all concrete work, saving labor and expense. In this simple construction merely set up the HY-RIB sheets and apply the concrete or plaster. HY-RIB also cuts down weight and saves valuable floor space.
Used with equal success in structures of all types—factories, warehouses, offices, stores, hotels, public buildings, residences, garages, silos, culverts, etc.
Valuable HY-RIB Hand Book, full of useful suggestions, Free. Write today.
TRUSSED CONCRETE STEEL CO.
Dept. H-2. Youngstown, O.
Reinforcement Metal Lath Steel Sash
Armor Plates Waterproofing Specialties
KAHN Building Products
PARTITIONS INSIDE FURRING
SIDINGS OUTSIDE WALLS
FLOORS BELOW CONDUITS

WE TEACH Retail Advertising, Window Trimming, Show Card Writing, Salesmanship

In order to acquaint you with our school and methods of instruction, we will mail you *free* our new fifty cent book, entitled

TEN DISPLAY MANAGERS TELL

With this free book we will also include our complete list of over one hundred fifty business books, especially suitable for the retail store's library. A postal request will bring both.

Economist Training School 231-243 W. 39th St., New York City

Obtain Better Work **Red Devil No. 1650**

¶ This is a bonded heavy side cutting plier, with each tool is packed an insurance Bond covering two years of service.
¶ The head is highly polished and the handles are dentyne milled, assuring a perfect grip. The handles are of the latest scientific design that fit the hand without tiring.
¶ You need this tool in your tool chest. Get it from your dealer or send $1.75 for one sample only of No. 1650 8-inch. We will present you with a genuine leather scabbard.

Send for Booklet of 3000 Red Devils.

SMITH & HEMENWAY CO., Inc., 155 Chambers Street, New York, N. Y.

ELECTRIC LIGHTING FOR AMATEURS How a small and simple experimental installation can be set up at home. Scientific American Supplement 1551. Price 10 cents. For sale by Munn & Co., Inc., and all newsdealers.

EPICYCLIC TRAINS, which play an important part in toothed gearing, are ably described in Scientific American Supplement 1524. Price 10 cents. For sale by Munn & Co., Inc., and all newsdealers.

SYDNEY, AUSTRALIA
HONOLULU—SAMOA—SOUTH SEAS

The comfortable and pleasant route across the Pacific, winter or summer, is via *THE SYDNEY SHORT LINE* (19 days to Sydney). Splendid 10,000 ton American steamers (Lloyds 100 A1) sailing from *San Francisco* every two weeks for Honolulu and every 28 days for Sydney.

$110 HONOLULU {first-class round trip} **SYDNEY $300**

Honolulu is the most attractive spot on entire world tour. Swimming, surf boating, etc., at Waikiki Beach "beats them all." The world's greatest living volcano, Kilauea, can be reached by side trip.

SPECIAL TOUR SOUTH SEAS, $325—Honolulu, Samoa, Australia, New Zealand, Raratonga, Tahiti, etc.

Various other tours, including *Java, China, Japan,* and *Round the World.*

Send for folder.

OCEANIC S. S. CO., 673 Market St., SAN FRANCISCO

THE DOVETAILED KEY LOCKS THE PLASTER
BISHOPRIC STUCCO OR PLASTER BOARD
TRADE-MARK REGISTERED

Holds Stucco, Plaster or Cement so it **can't crack, crumble or loosen.** Saves **⅓ to ½ cost. Better** and **cheaper** than any other material. Makes construction **permanent.** Has withstood **severest tests** of building experts for **years.**

Let us prove it! Write for free sample, and booklet "Durable Homes by the Bishopric System."

THE MASTIC WALL BOARD AND ROOFING CO.
No. 600 Este Avenue CINCINNATI, OHIO

HUDSON Six-40 1915 Model $1,550 This Year F.O.B. Detroit

Our Level-Best Six

This new HUDSON Six-40, despite its price, marks our level best. Our 48 engineers, headed by Howard E. Coffin, have devoted four years to the car. In reply to all conflicting claims—defending higher prices—that's the most that we can say.

This car is the climax of HUDSON ambitions. We may do better some time, but we can't today.

There is hardly a part or detail which we find a wish to better. In fine engineering, in beauty and comfort, in lightness and economy, this car comes near the apex, we believe.

We say this after thousands have been tested on the road. After 12 months' experience with our last year's Six-40. After noting all the new-year models which our rivals have brought out. And we believe that most men will agree with us.

Its 48 Designers

There are 48 men—there have been for years—on the HUDSON corps of engineers. And Howard E. Coffin heads them.

It has never been claimed, so far as we know, that there is an abler corps in the country. And certainly there isn't.

In HUDSON models—constantly progressing—these men have fought over-tax. They have warred with all excesses—in weight and price, in upkeep and operative cost.

And this HUDSON Six-40 for 1915 marks the final result of their efforts.

Do Opinions Differ?

There are arguments, of course, which combat ours. Each maker defends his own. But we doubt if well-informed men seriously differ about this car.

HUDSON advances have always been combated. But the records show that the general trend has followed where we led.

Sixes are almost universal now in the upper grade of cars. Lightness is now demanded. Economy has been studied. Prices have come down. And HUDSON innovations in beauty and equipment are being fast adopted.

The HUDSON Six-40 this year differs from its leading rivals merely in degree of progress. It simply leads the common trend.

Where Hudson Leads

The HUDSON Six-40 leads in lightness among cars of this capacity. it reduces old-time averages about 1,000 pounds.

This lightness, plus a new-type motor, gives it class-lead in low operative cost.

It leads in beauty. In numerous ways it leads all in new styles of equipment.

In the quality field it holds the low-priced record, for cars that compare in size, class and capacity. Since last year our trebled output has reduced the price $200.

And, in designing, skill—not luck—has given this car amazingly perfect balance.

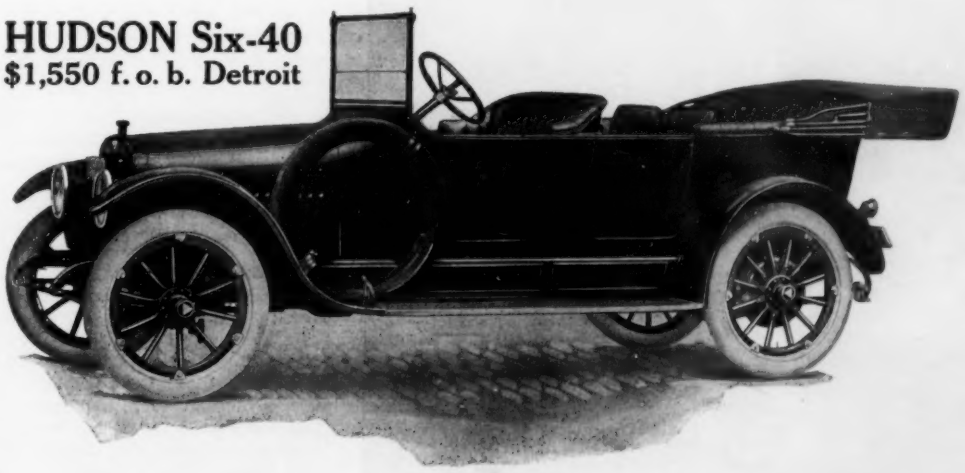
You'll Approve It

The more exacting you are, the better you'll approve this car. It will meet your conceptions in the things you want. In big ways and little ways it will show you to-day's best standards. We spent all last year on details and refinements.

Go see it, and bear this in mind: We build a larger car for the men who want it. But we could not, with our present knowledge, build a better car.

Hudson dealers are everywhere.
New catalog on request.

HUDSON Six-40
$1,550 f. o. b. Detroit



A perfect streamline body.
Seats and room for seven.
Disappearing tonneau seats.
Invisible hinges.
Hand-buffed leather upholstery.
Wide, high seats.
Gasoline tank in dash. Tires carried ahead of front door.

"One-Man" top with quick-adjusting curtains attached.
Dimming searchlights.
Locked ignition and lights.
Simplified starting, lighting and ignition system.
Wires in metal conduits.
New-form speedometer drive.

New-method carburetion.
Automatic spark advance.
Horn button in wheel.
Trunk rack on back.
Phaeton seats up to seven.
Also an ideal Roadster.
Also a beautiful Coupe.
Also a Limousine.

HUDSON MOTOR CAR COMPANY, 8186 Jefferson Ave., Detroit, Mich.

The Extra Guarantee

+Extra Experience
Extra Value
Extra Security
Extra Organization

INTO the crucible go the ideas of many men—of many firms—many great manufacturing centers—many countries. They melt and blend, and from their fusion comes a motor free of the dross of inexperience, of guess-work, of freakishness,—comes a fusion, clean, refined—a Continental Motor.

Continental Motors

Over one hundred firms—American and European—use the Continental Motor in some of its several models. Weigh the importance, the significance, of their combined O Kay! Judge the soundness of design that passes more than a hundred censorships; of the sureness of construction that five-score companies link their reputations with!

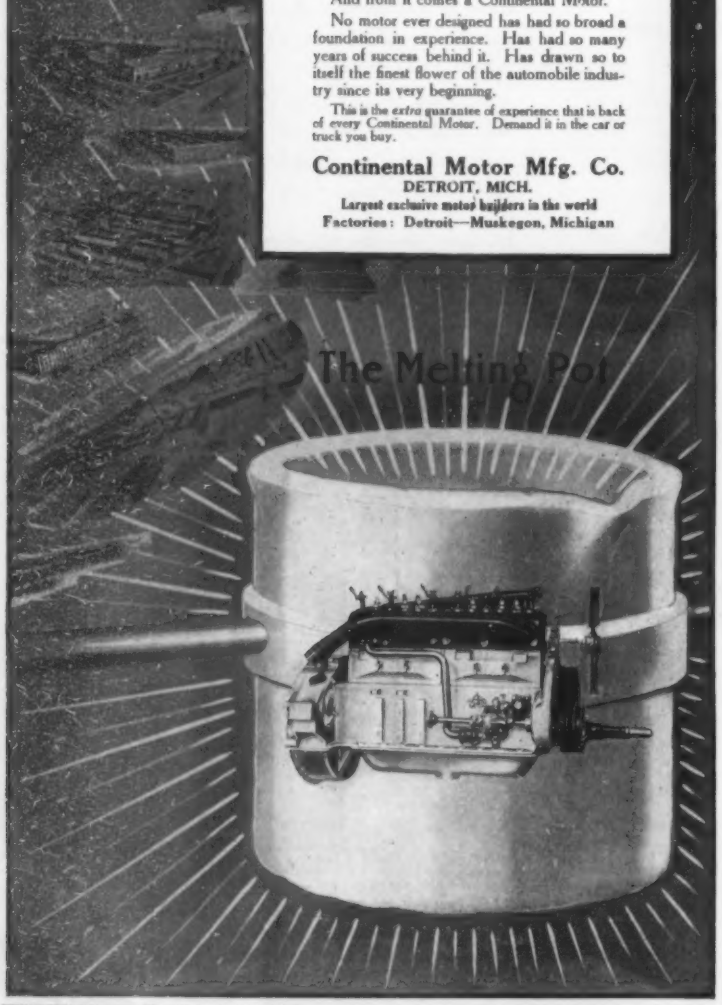
All the ideas of these skilled manufacturers are gathered. All that the leading engineers of two continents devise. Into the melting pot they go—ideas American, English, French, Italian, German—ideas of firms large and small, Continental ideas—all!

And from it comes a Continental Motor.

No motor ever designed has had so broad a foundation in experience. Has had so many years of success behind it. Has drawn so to itself the finest flower of the automobile industry since its very beginning.

This is the *extra* guarantee of experience that is back of every Continental Motor. Demand it in the car or truck you buy.

Continental Motor Mfg. Co.
DETROIT, MICH.
Largest exclusive motor builders in the world
Factories: Detroit—Muskegon, Michigan



HOW TO BUILD A 5 H. P. GAS ENGINE AT HOME

In *Scientific American Supplements*, 1641 and 1642, E. F. Lake describes simply and thoroughly how a five horse power gas engine can be built at home. Complete working drawings are published, with exact dimensions of each part. Price by mail for the two Supplements, 20c. Order from your newsdealer or from
MUNN & COMPANY, Inc. *Publishers* 361 BROADWAY, NEW YORK

Feeding the Man on the Firing Line

(*Concluded from page 165.*)

2. By utilizing the resources of the country.

It is generally necessary to utilize to the fullest extent the food, especially the forage, available in the theater of operations. In former times the invader possessed the right of booty and pillage, the resort to which was most unfortunate for the army, as it embittered the population and compromised the safety of the troops in an enemy's country, and in the event of any real or imagined injury being done them, it gave rise to redress and reprisals. It furthermore caused the interruption of all commercial transactions, and stores were not offered for sale, as private individuals were compelled to submit their supplies to the rapacity of the enemy. These evils were in a measure remedied by not taking directly from private individuals, but by making upon the civil officials certain demands called requisitions, for a specified quantity of supplies necessary for the troops. The local authorities could apportion the demand among the inhabitants, according to the known means of each, or could procure the stores by purchase. The former practice of spoliation thus assumed the milder form of a war tax, regularly ordered and collected. This eventually led to the practice of giving receipts for the stores delivered, and the indemnity for the same was the next innovation. All these modifications were, of course, only introduced after a great interval of time.

Requisitions have been defined as demands for necessary supplies and services made on the inhabitants of certain districts or localities, *through their civil authorities*, to satisfy the requirements of an army. They are accompanied by force, if it is necessary to resort to such extreme measures, to exact the fulfillment of the demands.

During the Franco-Prussian war of 1870-1871, the Germans obtained by requisitions in France one third of the food supplies and forage required for their large armies, and the receipts given for these supplies stated that they would be paid for by the *vanquished*.

Billeting or Quartering.—Supplies of food are, as a rule, to be found for several days in every town or village, and each householder usually has a sufficient quantity to provide his family for a few days, consequently, at least the same number of soldiers as there are individuals in the household can obtain subsistence there for a day or two. This method is the one which distributes more uniformly, if not in the best way, the burden of the subsistence among all the inhabitants, and makes it possible to subsist the greatest number of men in a given section of a country.

An exception should always be made in favor of the poorer classes, who at the best of times, are barely able to provide for their own families.

The following exceptions are usually made:

First. Any householder who has entertained a wounded man in his house is "exempted from the quartering of soldiers." (Article V, Geneva Convention of 1864, acceded to by United States, March 1st, 1882.)

Second. Charitable institutions, hospitals, asylums for aged and infirm, religious communities of women, unprotected women, and educational institutions for girls should not have troops billeted upon them.

The advantage of this system is that the men at the end of a day's march find their meal ready cooked and prepared. The disadvantages are that it causes very great dispersion and separation of the different units. In addition, this method may lead to oppression on the part of the troops, if they are not treated as liberally as they consider they should be. The dispersion of the troops prevents the officers enforcing strict compliance with orders and is subversive of discipline.

A supply of uniform clothing must be provided from the home country, and a sufficient reserve available at all times to

Would You Spend One or Two Years—and a Lot of Money—Testing Samples that Couldn't be Duplicated in Quantities When the Test was Finished?

The test wouldn't do you much good, would it?

HIGH SPEED NON-GRAN BEARING BRONZE

NON-GRAN is the finest of all bearing bronzes for the resistance of frictional pull and wear. And NON-GRAN, *physically* as *well* as chemically, is uniform year after year.

If you can't visit our works, write us and ask us to explain how we insure this positive, year in and year out, uniformity of NON-GRAN.

NON-GRAN is the bearing bronze used in the manufacture of the

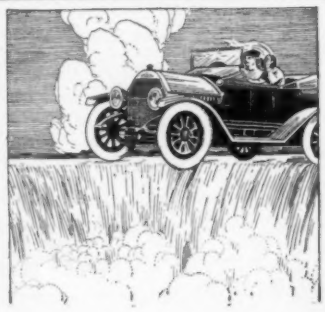
"PACKARD" *"LOCOMOBILE"*
"SIMPLEX" *"MARMON"*
"STEVENS-DURYEA" *"SAURER"*

and the score of other cars that *stand up uniformly.*

NON-GRAN is the bearing bronze you can count on to back up, and make good, the design and workmanship on *your* machines.

Mail us blue prints of your bushings and get the unbiased counsel of our Engineering Department. This service is gratis to any manufacturer of machinery.

AMERICAN BRONZE COMPANY
940-980 CARTON BOULEVARD
BERWYN, PENNSYLVANIA



It's a safe bet you will never need to

Stop Your Car on the Brink of Niagara

BUT you can save yourself in many a tight place that would otherwise spell S-M-A-S-H—U-P and, perhaps, Death—if you have your brakes lined with

Thermoid HYDRAULIC COMPRESSED Brake Lining-100%

When you set your brakes lined with Thermoid they take hold noiselessly—they grip—you STOP!

That's because Thermoid is brake lining from top to bottom—just as full of friction or gripping power in the center as on the outside—with 50% more material *in* it and 60% more labor *on* it than any ordinary lining.

Thermoid won't burn up on a long, steep, down-hill run. Oil, gasoline, water, heat, dirt, won't affect it and it will outwear any other brake lining, bar none.

Our Guarantee—
Thermoid will make good—or WE will.

Specify it on your 1915 car—order your repair man to put it on your car in service now.

Thermoid Rubber Company
Trenton, New Jersey, U.S.A.

1915 Chalmers Cars

"Sixes" Exclusively

"LIGHT SIX" 5-PASSENGER—$1850

New body styles, refinements of detail, continued use of the well-tried Chalmers Chassis, and a slight increase in price. These are the striking features of the Chalmers line for 1915

The Chalmers "Light Six" is now offered in both five- and six-passenger types with new bodies of latest style and design—in every way a distinguished car. The five-passenger model is a big, roomy car in comparison with high-powered "Sixes," but not skimped in design.

The six-passenger model —at $1900—is a car of exceptional grace and roominess, with an entirely new, luxurious and distinctive body. The tonneau is fitted with Pullman disappearing seats. Doors are unusually wide. The body is a new type of exclusive Chalmers design.

This "Light Six" is the proved 1915 car. 4000 of these cars have been driven an aggregate of 3,000,000 miles and they have universally made good.

When we first announced this car we priced the five-passenger car at $1800. We have since added a few detailed improvements and made some changes which have increased the manufacturing cost approximately $50. So beginning August 1st the price of the five-passenger model became $1850. At the new price our factory profit remains the same.

The "Master Six" of Them All

The new 1915 Chalmers "Master Six"—$2400—will be produced in limited quantities for those who seek the fullest luxury of power and size in a motor car

For 1915 the "Master Six" is offered in two body types, the four-passenger Torpedo and the seven-passenger Touring Car. Both types are unusually beautiful and distinctive. The price of either type is $2400.

The four-passenger Torpedo is a most distinctive car. It has exclusive style and dash. This beautiful new body has a single door on either side. Front seats are divided, the doors being in the center of the body.

This is a man's car of universal style and smartness, built lower than usual, giving it a foreign, racy appearance and making it distinctive among other cars.

The "Master Six" seven-passenger Touring Car is a big, roomy car, for those who drive an automobile of maximum carrying capacity. The lines of the seven-passenger body are the same as those of the Torpedo.

Chalmers Cars— Quality Cars

"Quality First" will continue to be the guiding principle of Chalmers manufacture for the coming season. It is to carry out this principle even further than in the past that we have raised the Chalmers prices.

The Chalmers Company is not competing and never has competed with other cars on a "price" basis. Our past experience has shown us that each year there are enough people to whom "quality" is first and "price" secondary, to buy more Chalmers cars than we can make.

So the Chalmers Company is one of those sure enough of its market to continue to produce cars on a "quality" basis rather than on a "price" basis. The new prices, $1850 for the Chalmers "Light Six" and $2400 for the "Master Six," mean no more profit per car to us, but they mean to you even more value in the future than in the past.

See These Cars

Arrange with your local dealer to see these Chalmers "Sixes." Take a ride in the car that appeals to you most. Place your order early. The production of Chalmers "Master Sixes" is limited and will not fill the demand.

Quality First

Features of Chalmers "Sixes" for 1915

Chalmers Bodies—We call your attention especially to the Chalmers body designs for 1915. The bodies of both the Light Six and the "Master Six" are distinctly original. They have been pronounced by experts to compare favorably in looks with the best European cars to which the world always looks for exclusiveness of body design. The words "Genuine Streamline" are so much abused that we do not use them in describing Chalmers bodies. See the new models yourself; then you can appreciate how distinctive they are in grace and style.

Flexible Power—Both 1915 Chalmers "Six" motors are exceptionally long stroke. At two miles an hour on "high" or at express train speed, you feel the big reserve of pull and stamina. You never feel uncertain of a Chalmers "Six," and the need for gear shifting is rare.

Roadability—Chalmers "Sixes" ride well. They cling to the highest crowned road. That's because their weight is rightly balanced, because all torsion strains are taken up by big strong torque tube and rod. In building for strength and safety, Chalmers design leaves nothing to chance.

Molded Oval Fenders—introduced by Chalmers last year and declared by owners "the handsomest fender built." Give fullest protection from dirt.

Tungsten Steel Valves—Will not warp or pit. Almost never need regrinding. Assure full and lasting power. Cost more, but are worth more.

Medium Weight—Both Chalmers "Sixes" are designed for lasting and satisfactory service. They are heavy where weight is needed; and do not carry a superfluous pound. In proportion to power, as economical as any. Heavy enough to be safe in any emergency, comfortable on any road.

Complete Equipment—All open cars have electric starter, Chalmers tailor made top, rain vision windshield, Klaxon-made horn, demountable rims, full electric lights. No car carries better equipment or is more convenient.

"MASTER SIX" TORPEDO—$2400

"Master Six"	4-Pass. Torpedo	$2400
"Master Six"	7-Pass. Touring Car	2400
"Light Six"	4-Pass. Touring Car	1850
"Light Six"	6-Pass. Touring Car	1900
"Light Six"	2-Pass. Coupelet -	2100
"Light Six"	4-Pass. Sedan - -	2850
"Light Six"	7-Pass. Limousine	3300

Fully Equipped (F. O. B. Detroit)

Please send me literature on the 1915 "Light Six" and the 1915 "Master Six"

Name.....

Street..... Town.....

State.....

S.A. 9-5-14

Chalmers Motor Company, Detroit

Trouble-Savers

For the Users of No-Rim-Cut Tires

These are four of the greatest features ever employed in tire making.

Each combats, in the best way known, one of the major tire troubles.

All four are exclusive to Goodyear No-Rim-Cut tires. That is why these tires rule. No other tire in the world to-day has so many users.

The Four

To end rim-cuts, these tires alone have our No-Rim-Cut feature. It completely wipes out this chief cause of tire ruin, in the only satisfactory way that's known.

To save blow-outs—to remove one of the main causes of them—we give these tires an "On-Air" cure at an extra cost of $1,500 daily. No other maker does that.

To combat loose treads, we form in each tire, by a patent method, hundreds of large rubber rivets. They reduce this risk 60 per cent.

For an anti-skid we give you our double thick All-Weather tread. It is flat and smooth and regular, so it runs like a plain tread. But it grasps wet roads with deep, sharp, resistless grips.

You Want Them

You want these trouble-savers. Every motorist wants them. This is to urge you to get them.

Hundreds of thousands get them now in Goodyear No-Rim-Cut tires. No man gets them in any other tire.

You get with them in Goodyears, in every way, the utmost in quality tires. And you get them at prices which mammoth production has reduced to the farthest limit.

They mean to you safety, sturdiness, strength—maximum mileage and minimum trouble. And any dealer, if you ask him, will supply you these premier tires. For your own sake, get them.

GOODYEAR
AKRON, OHIO
No-Rim-Cut Tires
With All-Weather Treads or Smooth

THE GOODYEAR TIRE & RUBBER CO., Akron, Ohio

Toronto, Canada London, England Mexico City, Mexico
DEALERS EVERYWHERE
Branches and Agencies in 103 Principal Cities (1855) Write Us on Anything You Want in Rubber

Saves Its Cost Quickly

Oxy-Acetylene welding offers a saving in manufacturing costs:

(1) In uniting parts quickly, as strong as the metal itself.
(2) In building on projecting parts.
(3) In cutting processes.
(4) To remove defective castings.
(5) In quick, permanent repairs of machinery.

Every manufacturer should have our information bulletins on this process. It will show a big saving in your business.

Prest-O-Lite For Oxy-Acetylene Welding & Cutting

makes the outfit portable, cheaper in first cost, cheaper to operate, never depreciates in value, and saves time and money in every operation. It gives greater heat and because of the purity of the gas makes stronger, better welds. Stored in cylinders, it is backed by universal service.

No matter what outfit you employ, no matter what use you make of acetylene, Prest-O-Lite acetylene service means the maximum of quality, convenience, safety and economy.

Let us send you interesting data on Prest-O-Lite welding and our proposition on Prest-O-Lite acetylene service. You'll need this some time—why not write today?

The Prest-O-Lite Co.
INC.
810 Speedway, INDIANAPOLIS, IND.
Branches and Charging Plants in All the Principal Cities.

Backed By Prest-O-Lite Service

The Prest-O-Torch (Acetylene Blow-Torch)
Takes the place of the gasolene blow-torch for soldering, brazing, tempering tools, etc. Safer, surer. Costs less to buy and less to operate. Gives greater heat in a concentrated flame. Perfectly convenient. No repair expense. Absolutely safe. Complete information on request.

replace the losses which occur in active service. In some of the foreign armies the first reserve of clothing is composed of 10 per cent of trousers and shoes; 5 per cent of caps, coats, and overcoats. These percentages are calculated on the maximum war strength of the organization. In those armies every soldier's kit must at all times contain an absolutely new uniform; this uniform the man is required to put on only when the order for mobilization is received. The troops, consequently, march into the field in new clothing, which arrangement very greatly reduces the demands upon the reserves during the campaign.

A study of the orders given by Napoleon indicates the care he exercised to have a sufficient supply of shoes provided. On one occasion he wrote, "You know that shoes are always needed in war"; and at another time he said to Baron Lejeune, "Shoes help on marches, and marches win battles." To Sir John Burgoyne's question addressed to Wellington, "What was the first requirement of a soldier?" "A good pair of shoes," he replied. "And the second requirement?" "A good pair of shoes for a change." "And the third?" "A pair of soles for repairs."

In the foregoing discussion attempt has been made to outline in a very brief and cursory manner the supreme importance of the supply of an army in the field and the stupendous task imposed upon the officers charged with the execution of the same.

The results of a campaign are gaged by the victories and other feats of arms, which are exhaustively described by the many participants therein; but it is very seldom that adequate credit is accorded the efforts of the administrative officers who indirectly contribute very greatly to the successful issue, although the work of such officers never ceases, and cannot flag for one instant. When the army is on the march the supply departments are strained to their utmost to provide its wants, and when it halts to recuperate its strength, the same unremitting care and attention must be given by the administrative officers. As Daru says: "This is perhaps the only service which takes no rest during war."

The Nerves of an Army

(Concluded from page 167.)

try test, is now placed in the National Museum as a monument to that pioneer achievement, and should be an incentive to this country to regain its pre-eminence in aeronautical progress. Within the limited means at its disposal, the Signal Corps in the five years since aviation began, has been training the few officers whose services could be spared under former provisions of the law. It has acquired sufficient biplanes from American aeroplane manufacturers for the limited training possible. Under the more liberal provision of officers and men now made in the law, and the correspondingly increased appropriations hoped for, rapid strides will be made in securing modern high power machines and the skilled aviators to run them. Under recent War Department orders, an aviation organization is authorized, called a "squadron." This is divided into two companies. Each of these companies is equipped with four aeroplanes. Each aeroplane and its appurtenances, with the necessary personnel, constitute a section. The aeroplane squadron consists of twenty officers and 90 men. To supply, keep in repair, and transport the eight aeroplane sections and the headquarers, sixteen automobile "tractors" and six motorcycles are proposed to be used. These automobile tractors transport the personnel, the dismounted aeroplanes, spare parts, and the necessary fuel (gasoline and oil). Included among the tractors is a portable machine shop. Such an aero squadron is considered the necessary tactical unit to serve with a division, having in view its best employment as a means for collecting and transmitting information.

In the foregoing general statement, the field duties of the Signal Corps are only briefly touched upon. An extensive system of coast information and patrol stations, involving radio and other means of inter-communication, would need to be established in time of war, which would undoubtedly depend upon Signal Corps control. The Signal Corps would also be called upon to lay and repair submarine cables and operate cable stations, as it does in the peace establishment in connection with the cable system from Seattle northward to Alaskan ports. It would provide and distribute the code and cipher systems so important in modern war, especially since the extensive employment of radio-telegraphy. In conjunction with other arms, the collection of photographic data by the Signal Corps, especially with improved field tele-photo apparatus now devised, will be most important for map and other graphical information.

From Fighting Line to Hospital

(Concluded from page 169.)

Here he observes many cases being brought in; an operating table has been improvised by placing a litter on top of four posts, and some operating is going on. He is told that under the tent flies pitched a short distance away are numbers of seriously wounded. At length four ambulances arrive and he, with others, is placed in one, and after riding an hour over a rough trail he arrives at the field hospital, which is in tents, no buildings being available. This hospital has a capacity of two hundred and sixteen beds. Here a careful record is made of his case; he is taken into a ward tent, his soiled and bloody clothes are taken off, he is given a suit of pajamas, and placed on a bedsack filled with straw and laid on the ground. He is furnished with a pillow and blanket, and a rubber blanket to use in case of rain. Light diets are served the patients. The hospital rapidly fills up, and just at dusk he is again placed in an ambulance and turned over to a Medical Officer, who verifies carefully each of the occupants of the ambulance and the property he carries with him, for the reason that Private B here passes out of the control of the Division Commander and into the jurisdiction of the Line of Communications. After an hour's ride he arrives at the Evacuation Hospital, which has a capacity of three hundred and twenty-four beds. Here he finds comfortable cots, abundant bedding and food. The next morning he is placed on a hospital train and conveyed to the base, where he finds himself in a hospital of five hundred bed capacity, with skilled physicians, trained female nurses, and an abundance of supplies of all kinds. Here he makes an uneventful recovery, and after spending ten days in the convalescent camp, returns to his regiment.

It will be noted throughout this statement of these plans that there is no mention made of the regimental hospital of former days. The old policy permitted the retention of sick at the front, encumbering the movement of troops. The present plan, which is now adopted by all the great powers, contemplates sending all sick to the rear, where facilities are abundant and where they can receive better attention than was ever possible when they were retained with their regiments.

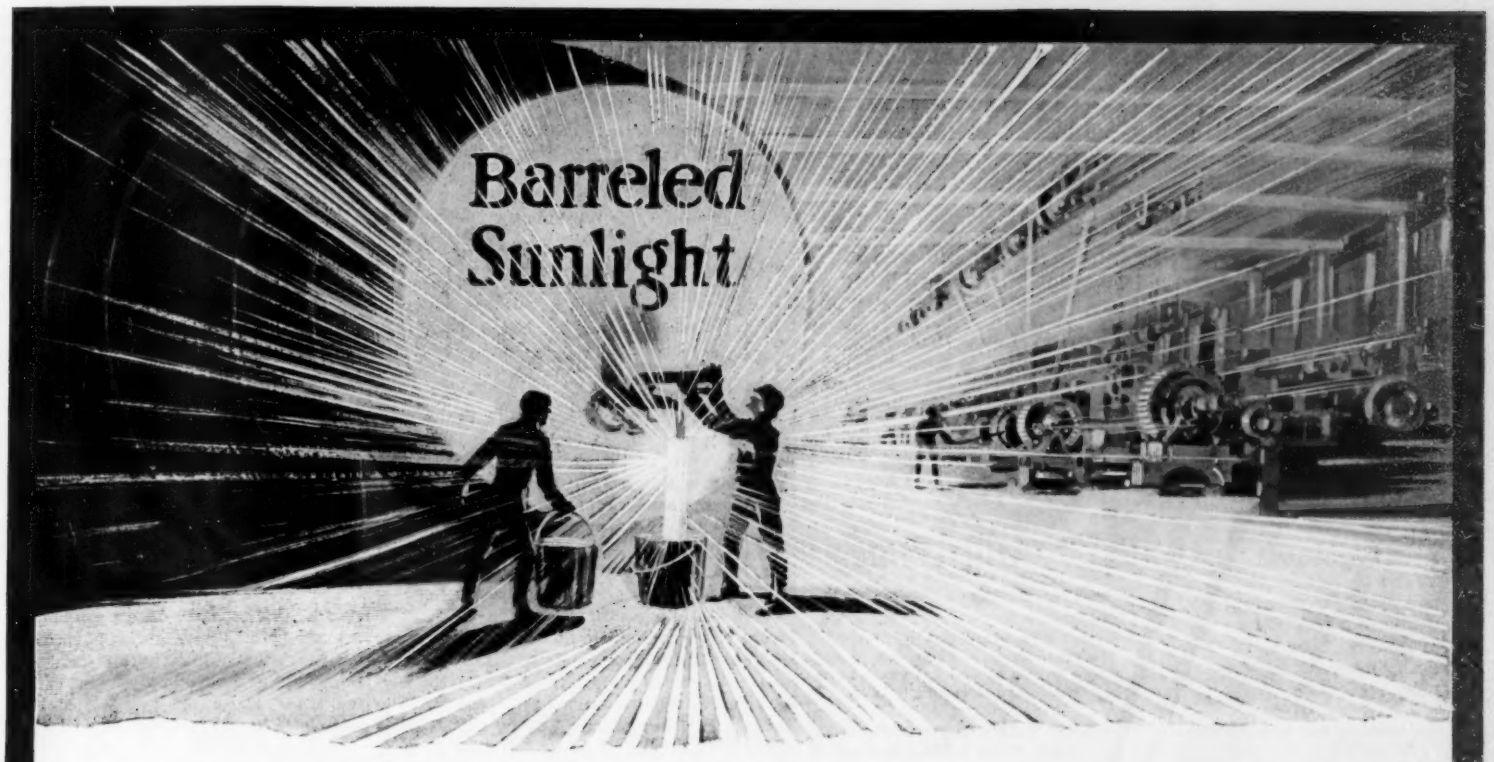
Aircraft in War

(Concluded from page 172.)

Army Exercises. On page 172 a list of Zeppelins is given, in which army, navy, and passenger carrying vessels are included, and which is about as accurate as can be compiled at the present time. The list includes only vessels which are actually available and ships which can be finished in a few weeks.

From these tables it will be seen that most of the German airships of whatever type have speeds well above 45 miles an hour. The actual number of airships which Germany has at the present time available is not less than 23.

Just what the German aeroplane strength is—or for that matter the aeroplane strength of any power—is a matter of guessing. When it is considered that the flying machine of to-day can be produced in quantities as cheaply and quickly as a torpedo, statistics of flying machines



3,243 plants are now filled with this sunshine

The Electrical Testing Laboratories, New York, found that Rice's Gloss Mill-White gave 19% to 36% more daylight, depending upon the conditions in the plant. (Read the Kellogg letter in box below.)

It *reflects* the light, instead of absorbing it. It throws daylight into dark corners. It saves greatly on electric lighting bills. It enables employees to work better, because they can *see* better. Moreover, it is the most sanitary interior paint. It can be *washed* with soap and water, without killing the gloss.

Because it stays white longer than any other gloss paint, Rice's Gloss Mill-White requires *less frequent repainting*. Another striking economy and convenience is that *it can be applied over cold water paint.*

Below are a few letters, out of literally hundreds, telling what it has done. Still stronger proof that it is best can be secured *in your own case*, by our open guarantee. Now is an opportune time to repaint; we invite stringent comparison of Rice's Gloss Mill-White with every other interior finish.

A Few of Many Users

General Electric Co.
Pierce Arrow Motor Car Co.
Ford Motor Car Co., Detroit, Mich.
Eastman Kodak Co., Rochester, N.Y.
Gillette Safety Razor Co., Boston, Mass.
Cluett, Peabody & Co., Troy, N. Y.
Royal Typewriter Co., Hartford, Conn.
General Fire Extinguisher Co., Providence, R. I.
Waltham Watch Co., Waltham, Mass.
United Shoe Machinery Co., Beverly, Mass.
Seaconnet Mills, Fall River, Mass.
Lancaster Mills, Clinton, Mass.
Whitin Machine, Whitinsville, Mass.
New Nashawena Mill, New Bedford, Mass.
Graniteville Mfg. Co., Graniteville, S. C.
West Point Mfg. Co., West Point, Ga.
Quissett Mills, New Bedford, Mass.
Berkshire Cotton Mfg. Co., Adams, Mass.
Foster Machine Co., Westfield, Mass.
Bullard Machine Tool Co., Bridgeport, Conn.
Massachusetts Mills in Georgia, Lindsdale, Ga.
The Pell City Mfg. Co., Pell City, Ala.
Indian Head Mills of Alabama, Cordova, Ala.
Pelzer Mfg. Co., Greenville, S. C.
Waterbury Farrell Foundry and Machine Co. Waterbury, Conn.
Tremont and Suffolk Mills, Lowell, Mass.
Whitman Mills, New Bedford, Mass.
Diamond Chain and Mfg. Co., Indianapolis, Ind.
Chadwick-Hoskins Co., Charlotte, N. C.
Merrell-Soule Co., Syracuse, N. Y.
Brighton Mills, Passaic, N. J.
Renfrew Mfg. Co., Adams, Mass.
Hood Rubber Co., Boston, Mass.
Greylock Mills Co., N. Adams, Mass.
Utica Steam and Mohawk Valley Cotton Mills, Utica, N. Y.
Dwight Mfg. Co., Chicopee, Mass. and Alabama City, Ala.
Wm. A. Slater Mills, Jewett City, Ct.
Fall River Bleachery, Fall River, Mass.
Edwards Mfg. Co., Augusta, Me.

Why it is better than imitations

Rice's is the original Mill-White; all others are imitations and they can imitate only for a short time. For this *is the only Mill-White made without varnish*. For that reason it does not crack and scale like others; it does not flake off with the jar of machinery. It is made by a special process, *discovered and owned exclusively by the makers*. There can positively be no substitute which gives as good service.

Imitation "Mill-Whites" may look as good when *first* put on. But six months' exposure will prove their inferiority. By that time many are so yellow that they might be yellow paints. Repeated tests have shown, *without a single exception*, that Rice's remains white longer than any other.

Guaranteed to Remain White Longest

These are far from being mere claims. We give an unequivocal guarantee, with every trial, that if Rice's does not remain white longer than any other gloss paint—applied at the same time and under similar conditions—we will give free enough Rice's to repaint the job with one coat. We give a similar guarantee that Rice's will not flake or scale. In other words, you can prove our claims, in your own case, *at our risk*. You cannot lose under these guarantees.

Even more liberal test offers will be made to those having 20,000 square feet or over to cover. Tear out the coupon now, and give it to your stenographer, with instructions to "write on our letterhead, and have the reply come to me personally." We will send complete information and sample board.

One coat of Rice's Granolith makes best possible primer on inside concrete and brick, for a second coat of Rice's Mill-White

RICE'S GLOSS MILL-WHITE

U. S. Gutta Percha Paint Co.

23 Dudley Street Providence, R. I.

What a Few Users Say

Sanitary conditions in our plant have improved wonderfully. We should judge we are getting 50% more light than before.—**Kellogg's Toasted Corn Flakes Co.**, Battle Creek, Mich.

We are indeed astonished to note the vast amount of daylight created by this paint—especially where we were formerly forced to use electric lights all day. Now find it entirely unnecessary. Agreeably surprised to observe how easy it is to keep clean.—**Knotair Hosiery Co.**, Philadelphia, Pa.

The most practical interior finish we have ever used on walls and ceilings. We imagine we will show an increase of between 20 and 25% in light.—**R. J. Reynolds Tobacco Co.** (Makers of Prince Albert.)

Find it very satisfactory indeed.—**Gillette Safety Razor Co.**

The best thing we know of.—**H. Doherty Silk Co.**, Paterson, N. J.

Tested it in competition with several other makes. The architect and owners respectively, Mr. Pitt and Canadian Yale & Towne Co., agree that yours is the best in appearance.—**F. Telford**, Niagara Falls, Ont.

Still pleased with the finish which was applied three years ago. Is in as fine and permanent condition as when applied. — **General Fire Extinguisher Co.**, Providence, R. I.

Out of six comparative tests, Rice's Mill White leads. — **Killingly Mfg. Co.**, Killingly, Conn.

We gave your paint a severe test in connection with several brands and your paint stood the test the best, and gave complete satisfaction. —**The American Pin Co.**, Waterbury, Conn.

U. S. GUTTA PERCHA PAINT CO.
23 Dudley St.
Providence, R. I.

Tear out this coupon as a reminder to have your stenographer write us on your letterhead for further particulars of *Rice's Mill White*, stating approximate size of main building, etc.

Approx. length _____ Approx. width _____
Number of Stories _____
Company _____
Address _____
Attention of _____

Light your plant with daylight

Here's a better Mill White

The scene below is a striking example of the difference a little paint makes inside of a factory.

Only one coat of Lowe Brothers Mill White has been applied to the farther part of the room—but see how much lighter it is. You can get the *same results* in your plant, with

Lowe Brothers Mill White

It will reflect and radiate the light that comes through the windows—multiply your daylight—give your men better working conditions, save them time and eye strain, save yourself gas and electricity bills.

Lowe Brothers Mill White is the kind of paint you'd expect to come from this house of quality. It's specifically made for its purpose.

It works well, spreads freely, has rare covering and hiding power in flat or gloss (even one coat of it will do wonders); it is washable and after wearing a long time, leaves a fine surface for repainting.

Get our book and get the whole story

Be sure to get the book before placing any orders for Mill White. It tells how and why Lowe Brothers Mill White is efficient—economical.

Give us an idea of the amount of surface you wish to cover and we'll arrange to make you a quotation.

Write us today

The Lowe Brothers Co.
474 E. Third St., Dayton, Ohio
Boston Jersey City Chicago
Kansas City Minneapolis
LOWE BROTHERS, Limited,
Toronto, Canada
See Sweet's Catalog, 1914 edition, pages 1916-1917

The

Autographic Kodak

Date and title your negatives permanently, when you make the exposures.

EVERY picture that is worth taking is worth a date and a title. The places you visit—interesting dates and facts about the children, their age at the time the pictures were made—the autographs of friends you photograph—these notations add to the value of every picture you make. Architects, engineers and contractors who make photographic records of progressive work, and the amateur who wants to improve the quality of his work can make notations with dates on the negatives, by means of the Autographic Kodak.

Just release a stop and a door opens in the back of the Kodak; write whatever notation you want; expose from 2 to 5 seconds; close the door and you are ready for the next exposure. On the margins between the negatives will appear a permanent photographic reproduction of the notation you made, and this can be printed or not, just as you choose.

The greatest photographic advance in twenty years.

No. 3A Autographic Kodak, pictures 3¼ x 5½ inches,	$22.50
No. 3 Autographic Kodak, pictures 3¼ x 4¼ inches,	20.00
No. 1A Autographic Kodak, pictures 2½ x 4¼ inches,	17.50

EASTMAN KODAK COMPANY,
At all Kodak dealers'. ROCHESTER, N. Y. *The Kodak City.*

mean little. During a conflict such as that which is now raging, the statistics, if they were known with any accuracy, would probably be found to change from month to month.

Germany's development of the military flying machine, however, is remarkable. France had incorporated the flying machine into her army a full year before the great General Staff of the German Empire determined to follow the French example in 1911. The steady growth of the dirigible, above all of the Zeppelin, and the lack of an aeroplane industry at all comparable with that built up in France in 1909 and 1910, were no doubt the chief reasons for this tardiness. In the brief space of three years, Germany has not only caught up with France, but may even have surpassed her. The best evidence of that is to be found in the new world records which have been made by German aviators—records which could not have been made without superb machines. To stimulate industrial interest in aviation the government as well as numerous private organizations offered prizes for machines and engines. It is interesting to note that many of the prizes were awarded for purely technical triumphs. In a single year (1912) the German public subscribed $1,750,000 for aviation. The amount of flying that is being done may be judged from the high aviation death rate—higher than that of any other country in Europe—as well as the experimental character of many of the latest inventions.

It is impossible even to state the number of machines which the German army can count upon. In a general survey of the aviation strength of Germany made for the London *Times* in 1913, by a special correspondent who visited the European aeroplane shops and gathered his information at first hand, the number of German machines is placed at not less than 200 or more than 250. That was over a year ago, and in a year a country so technical and martially active as Germany can do much. The German army is usually credited with 600 aeroplanes, which includes all the private machines that can be commandeered in time of war. That is probably too high; 500 is nearer the truth.

France as an Air Power.

Last January Emile Reymond, the most competent authority in the French Senate on military aeronautics, made some extraordinary revelations, which, if true, would place France far below Germany as an air power. In our opinion he has underestimated the French dirigible equipment. It is probably inferior to the German, not only in quality, but in organization; but it is much more effective and serviceable than he would have it, as the brilliant success that it achieved in the last maneuvers adequately proved. Senator Reymond's comparison may be here quoted with propriety, coming as it does from a French official, who happens at the same time to be an excellent pilot himself:

"Germany possesses fourteen dirigibles, of which seven are Zeppelin airships, capable of being used as destroyers. France has only seven dirigibles. The German have a capacity of 203,000 cubic meters; the French balloons have only a capacity of 54,000 cubic meters. The German dirigibles have motors of 600 and 800 horse-power. The German airships have a speed of 50 to 60 miles an hour; the French dirigibles scarcely have a speed higher than 35 miles an hour, and only one of them can attain a speed of 45 miles an hour. Seven of the German destroyers are powerfully armed and can be used effectively in offensive operations. They can carry each 25 persons . . . and 8 tons of weight, together with one ton and a half of ammunition. . . . The car is supplied with machine guns. . . .

"France has nothing to compare with this. . . . In 1911 France drew up a brilliant programme of dirigibles. It was to comprise heavy cruisers, light cruisers, and aerial scouts. But, alas! in the following year it was realized that the light cruisers and aerial scouts could not be of great service. Their construction was therefore abandoned, and it was decided in November, 1912, to build seven large cruisers with a capacity of 24,000 cubic meters each. Four of them were to be delivered in October, 1913, and three others in January, 1914. At present not one of these airships is completed. Only three of them are building and may be finished in a few months; but the construction of the other four has not yet been commenced."

The Senator's remarks are probably too severe. His estimate of the German airship strength as well as that of France is somewhat low, although he probably had in mind craft actually constructed and flying, whereas our tables include also vessels which can be made available for war.

FRENCH AIRSHIPS.

S. r. denotes semi-rigid; r., rigid; n. r., non-rigid.

Name.	Make.	Date.	Displacement in tons.	Length in feet.	Diameter in feet.	Speed in miles per hour.	Total horse-power.
Astra XVI. (n. r.)	Astra Co.	1914	38.0	7	7	60	1,000
Astra XV. (n. r.)	Astra Co.	1914	23.0	394	52	60	1,000
Conte (n. r.)	Astra Co.	1913	9.1	270	49	40	400
Lt. Chaure (n. r.)	Astra Co.	1911	9.0	285	49	32	330
Adj. Reau (n. r.)	Astra Co.	1911	9.0	285	49	32	240
Col. Renard (n. r.)	Astra Co.	1909	4.5	215	35	27	110
V. de Paris (n. r.)	Astra Co.	1906*	3.5	200	32	22	70
Dupuy de Lome (n. r.)	Clement-Bayard	1912	9.0	290	55	35	260
Adj. Vincenot (n. r.)	Clement-Bayard	1911	9.0	290	55	35	260
Capt. Marchal (s. r.)	Lebaudy	1911	10.0	293	51	28	160
Lt. Selle de Beauchamp (s. r.)	Lebaudy	1910	7.0	280	51	28	160
Liberte (s. r.)	Lebaudy	1910	7.0	280	45	33	160
Spiess (r.)	Zodiac	1912	20.0	459	47	45	400
Capt. Ferber (n. r.)	Zodiac	1911	6.0	249	43	35	220
Com. Coutelle (n. r.)	Zodiac	1911	9.5	303	49	38	400
Le Temps (n. r.)	Zodiac	1911	4.0	160	30	20	110
Fleurus (n. r.)	Government	1912	6.5	252	41	36	160
Clement-Bayard VI. (n. r.)	Clement-Bayard	1913	6.5	245	41	40	360

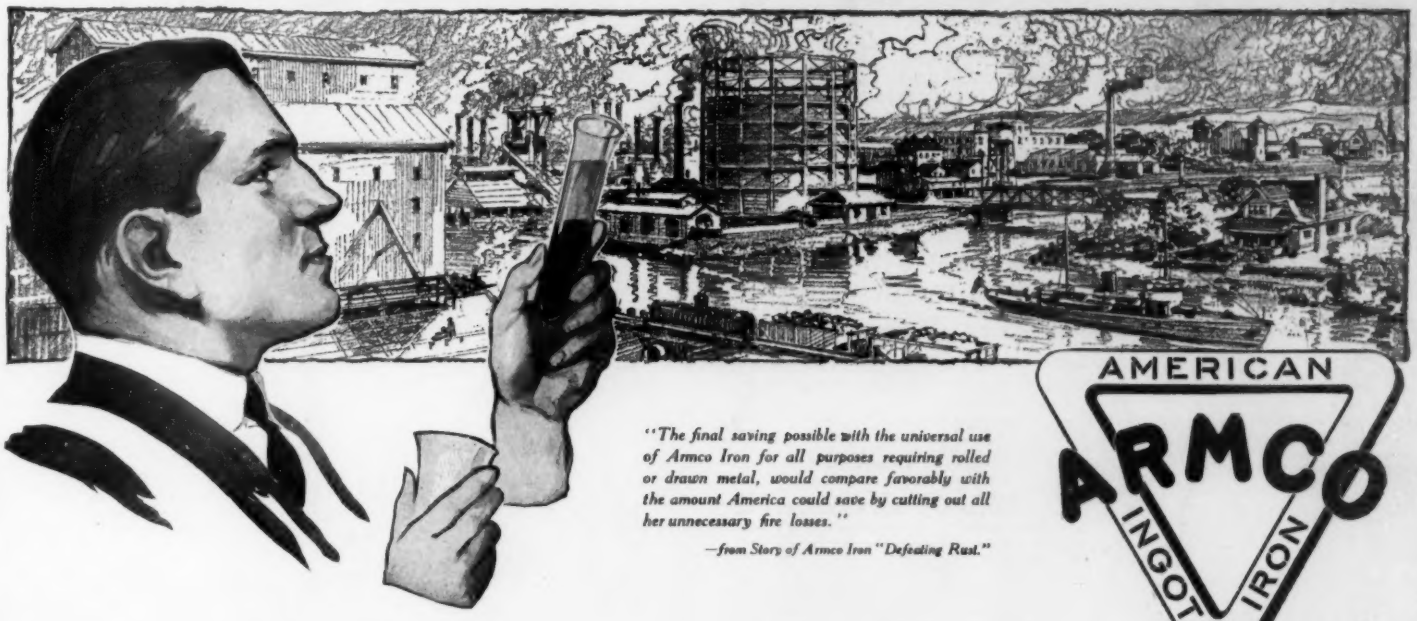
* Rebuilt 1908.

It is evident from the foregoing table that the French army airship material is rather of a varied character. The speeds are much lower than those of the German dirigibles. It is doubtful if most of the French ships can be effectively used in daylight warfare. The average aeroplane speed is much higher than the average French dirigible speed, which simply means that in daylight an aeroplane could out-maneuver nearly all French airships and subject them to fire.

The aeroplane strength of France is more accurately known than that of any other European Power, thanks to a controversy which was the direct outcome of the great National Aeroplane Subscription inaugurated some two years ago. It was alleged that the machines bought for the army were not new and that the orders for new machines fell short by two hundred of the number voted. While some manufacturers undoubtedly did seize the opportunity of foisting on the government aeroplanes of an old type, and while all the machines voted were not actually delivered, chiefly because of the limited output of some makers, the charges of dishonesty were not justified. The investigation made because of the controversy showed that 751 aeroplanes have been added to the aeronautic establishment of the French army during the past two years, and about 1,000 machines since the beginning of 1911. Because flying machines deteriorate rapidly, and because new types have been evolved for military use—types which are much faster than the monoplanes and biplanes used by officers in 1911—the effective aeroplane strength of the French army at the present time cannot be less than 500 first-class flyers.

Great Britain and the Air.

The British public has been taught to



"The final saving possible with the universal use of Armco Iron for all purposes requiring rolled or drawn metal, would compare favorably with the amount America could save by cutting out all her unnecessary fire losses."

—from Story of Armco Iron "Defeating Rust."

AMERICAN ARMCO INGOT IRON

ARMCO Iron Resists Rust

Our chemists save millions for the public

OVER one hundred million dollars' worth of sheet metal is made each year in this country. Most of it disappears shortly on account of rust. This is due to the fact that most sheet metal of the present day contains impurities such as carbon, manganese, silicon, copper, sulphur; therefore it cannot help rusting when exposed to air, moisture or corrosive gases.

Our chemists are saving millions of dollars for the public as a result of the discovery of two things: first, government experts established that the rapid corrosion of steel was due to its high content of impurities, especially manganese; second, we found the way to make pure iron. Either of these discoveries ranks as one of the greatest achievements in metallurgy.

Pure Rust-Resisting Iron Will Save Millions

Let us illustrate this saving of millions, literally. In a decade, most of the impure sheet metal made in 1914 and used in exposed situations will have been destroyed by rust. The sheet steel made in 1904 has mostly rusted away. There you have a complete, annual loss of nearly one hundred million dollars.

But as soon as the public realizes and accepts the great truth that pure iron is a resistant to rust, there will of course be little sheet metal used except pure iron. When that time comes, a waste of millions of dollars will be wiped out.

These are big figures, big claims—but they are true. Perhaps little figures will mean more to you. Let us say it will cost you $100 to roof a building with metal shingles or sheet metal. Ten years is about as long as you can count on modern impure metal roofing lasting. That is a cost of $10 a year. Pure iron roofing should last many times ten years. Even the old-fashioned charcoal iron roofs lasted forty to seventy years, and that iron was not as pure and not as rust-resisting as the pure iron which we are making. So instead of $10 a year, the cost of your roof will be nearer $2 a year.

Apply the same method of figuring savings to other sheet metal products; to metal window frames, metal lath, ventilators, gutters, pipes; especially to stoves, boilers, ranges and furnaces, which are peculiarly subject to rust, owing to condensation of moisture and to corrosive gases; to refrigerators; to road culverts, metal cars, boats, flumes, smoke stacks, tanks, woven wire fences and the thousand and one other things made from rolled or drawn metal.

ARMCO Iron Is Pure

Armco Iron is not only pure, rust-resisting—it is an exceedingly fine quality of metal for other reasons. Every process of manufacture is handled with extreme care and is under the supervision of very highly trained metallurgists. For instance, each sheet, after rolling, undergoes a slow annealing process which takes a week, although ordinary sheet metal is often annealed in a day. Slow annealing restores all of the original strength and evenness of texture and removes molecular strains caused by rolling. For this reason, Armco Iron is very ductile.

Armco Iron, when galvanized, shows practically no dissolution when the zinc is applied; therefore the zinc is not impregnated with iron particles and lasts much longer than the coating on an impure base.

The trademark **ARMCO** carries the assurance that Iron bearing that mark is manufactured by The American Rolling Mill Co. with the skill, intelligence and fidelity associated with its products, and, hence, can be depended upon to possess in the highest degree the merit claimed for it. It has behind it the guarantee of that company concerning the purity of the iron and the accuracy and thoroughness with which each step in its manufacture has been conducted.

Terne Plate Roofing

Armco Old Style Terne plate, with its Armco Iron base, is made by the Morewood hand dipped, old style, pure palm oil process. No acids are used. The coating is pure lead and tin—two almost indestructible metals.

There are seven operations. No higher grade metal roofing is made in the whole world. Each sheet is stamped Armco.

How to Get ARMCO Iron

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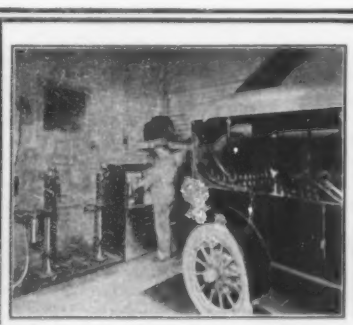

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believe by a critical press that Great Britain is hopelessly behind the Continent in aeronautics. That this is true enough so far as the number of pilots and machines is concerned cannot be denied, but it is equally true that the quality of the material at the disposal of the government is good. Col. Seely, who is probably the leading authority on flying machines in the British army, has stated that the Royal Aircraft Factory's machines are the best in the world for military purposes. No doubt he overstated his case; but in general design and workmanship the British machines are fully equal to those of France and Germany.

As in the case of the other Powers, it is impossible to estimate with any degree of accuracy the aeroplane strength of Great Britain. In naval and military periodicals the aeroplane strength of England is usually placed at about 250. Col. Seely's programme for 1913 called for a peace establishment of 127 machines, 154 officers, and 917 non-commissioned officers and men, with a reserve of 182 flyers for six months wastage in the field. The programme was to be carried out by the end of 1913—a manifest impossibility in view of the limited number of shops and mechanics. Assuming that it has been carried out this year, and that privately owned machines will be impressed into service, Great Britain ought to have not very much less than the 250 machines which it is commonly reputed as possessing.

In dirigibles, Great Britain is badly off. The catastrophe that befell the "Mayfly," Great Britain's first and only experiment in building and running a huge rigid dirigible, is responsible for a dirigible fleet which in numbers makes a poor showing in comparison with the splendid fleets of France and Germany. Germany lost Zeppelin after Zeppelin, but built new vessels, bigger, better, and faster than those which had been destroyed. The British government, on the other hand, became so discouraged after the "Mayfly" accident that it pinned its faith to the non-rigid vessels, and not many of these. All told, England can actually count on seven dirigibles. The non-rigids which took part in the last maneuvers were the "Delta," built in 1912, and the "Astra-Torres" and "Parseval," built in 1913. These vessels are slow, as speeds in the air go; for they are credited with less than 45 miles an hour. They proved quite useless in the high winds which marked the last British Army Exercises, and were out-maneuvered easily by swifter aeroplanes. England has building, however, a huge airship at the Vickers plant, which will have a speed of 50 miles an hour, and in addition five non-rigid airships with speeds of 46 to 47 miles an hour. It is not known how far advanced these vessels are. If her programme could be carried out, by the end of the year Great Britain would have fifteen dirigibles.

Belgium and the Air.

Belgium is credited with the possession of one non-rigid dirigible ("La Belgique III") built in 1910. This is a very small vessel of 200 horse-power with a speed of about 45 miles an hour. The craft is really built up out of the ruins of the "La Belgique I," which was all but destroyed in making a landing on April 28th, 1910.

It is known that Belgium has some aeroplanes, but how many nobody knows. No doubt the machines are of French manufacture, and manned chiefly by French pilots.

Enigmatic Russia.

Nothing very definite is known about the dirigible strength of Russia. She is known to have two airships ordered in France, whose construction can hardly be very far advanced, and three others in actual course of construction. So far as the records show there is only one Russian dirigible which seems to be in actual commission, and that is the "Astra XIII," which was built in 1913—a 35-mile an hour non-rigid driven by 400 horse-power engines. But it is reported that she can actually count on three ships.

Of the aeroplane strength of Russia nothing is known beyond the fact that Sirkosky has built two very large ma-

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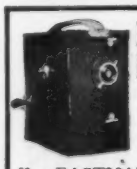

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chines, which are much too slow for effective military use. She is credited with 500 aeroplanes in aeronautical annuals, but that seems highly imaginative.

Austria-Hungary's Aerial Strength.

Austria-Hungary has three army airships, two of which are non-rigids, and the third a semi-rigid built in Austria from Lebaudy-Juillet plans. The speeds run from 25 to 35 miles an hour. Six Zeppelins are projected, but it is doubtful if these can ever be completed for financial reasons. There are in actual commission two passenger airships which might be available for military purposes. Of the Austrian strength in aeroplanes nothing at all is known.

A Comparison of Naval Strength

(Concluded from page 174.)

a vast preponderance in torpedo-boat destroyers, the Triple Entente having 342 as against 148 possessed by the Dual Alliance. In torpedo boats the figures are 198 as against 39, and of submarines, the Triple Entente possesses 169 as against 27 owned by the Dual Alliance.

The total tonnage of the three fleets of the Triple Entente is 3,168,051 as against 1,150,213 possessed by Germany and Austria.

Should the great war prove to be long drawn out, the question of the relative shipbuilding and repairing facilities of the contending nations would become of prime importance. Here the Triple Entente will have a decided advantage, because of their command of the sea and the absolute security of their shipbuilding yards and ordinance factories against attack; for it is not likely that the German invasion of France will reach any of her naval yards. In the earliest stages of the war, German shipbuilding, especially in the direction of completing the ships which are now under construction, will be carried on with feverish activity. Later, if the Russian invasion continues to advance along the shores of the Baltic, or in the unlikely event of a successful reduction of the German naval bases from the sea, the availability of the German yards for completing new ships, and making good the wastage of battle, might be seriously curtailed.

The Mistress of the Seas

(Concluded from page 178.)

one of the fastest class of destroyers, which showed on trial a speed of 34.5 knots. The British have shown a tendency in later vessels to increase the size and ocean-going qualities, keeping the speed down to 29 or 30 knots.

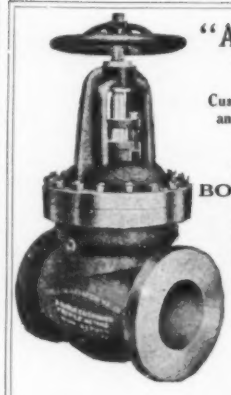
Particularly strong is the British navy in submarines. Slow at first to take up the new type of craft, when she was once assured of its value England entered into the work of developing and building submarines with great activity. The one herewith illustrated is of 600 tons displacement and 16 knots surface speed. Vessels of this class are now being built which are to be capable of making 21 knots on the surface and a proportionately high speed when submerged.

Russian Navy in the Baltic

(Concluded from page 181.)

Of battleships, Russia has in commission in the Baltic only four pre-dreadnoughts. The two most modern of these are the "Imperator Pavel" and the "Andrei Pervoswanni," which were laid down in 1903 and completed in 1911. They are improved "Slavas," and they embody improvements suggested by the Japanese war. They are of 17,400 tons, and 18 knots speed. The belt is 8½ inches, the upper belt 5 inches, and the rapid-fire battery protection is 3 inches thick. The armament consists of four 12-inch and no less than fourteen 8-inch and twelve 4.7-inch in the intermediate battery. The other two battleships are the "Slava" and "Tsarevitch," of 13,500 tons and 18 knots, protected by a 7¾—10-inch belt, and carrying four 12's and twelve 6's in turrets.

The most important of the armored cruisers is the "Rurik," of 15,000 tons and 21.5 knots, with a 6-inch belt, carrying a



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powerful armament of four 10's and eight 8's in the turrets, and twenty 4.7's behind 3-inch armor. The armored vessels of the "Admiral Makaroff" class are of 7,775 tons and 22.5 knots, with 7-inch side armor. They mount two 8's in turrets and eight 6's on the broadside. The "Gromoboi," 13,200 tons, and the "Rossiya," 12,500 tons, carry, respectively, a 6-inch and a 10-inch belt. Their speed is 20 knots, and each mounts four 8-inch and twenty-two 6-inch guns. They were completed in 1901 and 1898.

Of protected cruisers, Russia has in the Baltic two fast scouts, just completed, the "Moraviev" and the "Nevdskoy," of 4,500 tons and 27.5 knots, mounting eight 5-inch guns, and six older vessels, the "Juntchug," 3,050 tons and 24 knots; "Askold," 6,500 tons, 23 knots; "Bogatyr" and "Olef," 6,650 tons, 23 knots; and "Diana" and "Aurora," 7,600 tons, 20 knots per hour.

The most valuable asset of Russia in the Baltic is her torpedo fleet, consisting of 80 destroyers and 13 submarines. The earlier destroyers, built between 1895 and 1905, average about 370 tons displacement, and their speed is from 26 to 28 knots. The later boats, twenty in all, are from 500 to 650 tons, with speeds of 26 and 27 knots. A notable destroyer in size and speed is the "Novik," of 1,260 tons and 36 knots speed. Thirty-six new boats of this "Novik" class are being built and many of them will soon be available in the war. The Baltic fleet also includes 16 torpedo boats of from 120 to 200 tons, and from 21 to 30 knots speed.

The submarines built between 1904 and 1909 vary from 150 to 500 tons in displacement, with surface speed of from 9½ to 15 knots. A dozen new boats are being built, of large size and high speed.

Germany's Bid for Naval Supremacy

(Concluded from page 184.)

side. Their speed is about 21 knots. The "Prinz Adalbert" and "Friedrich Karl," completed in 1903, are generally similar to the "Roon" class. The "Prinz Heinrich," of 8,900 tons, completed in 1900, carries two 9.4-inch guns in two turrets, forward and aft, and ten 6-inch on the broadside. Her speed is 20 knots, and she is protected with 4 inches of armor. The "Fürst Bismarck," built in 1897, of 10,700 tons, mounts four 9.4-inch guns in two turrets, forward and aft, and twelve 6-inch on the broadside.

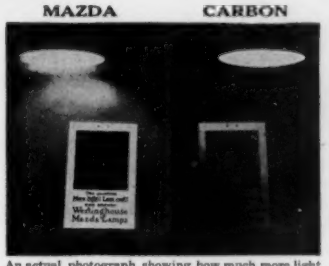
The German fleet is strong in protected cruisers and fast scouts, of which she possesses 41. The five ships of the "Freya" class, 19 knots speed, carry two 8.2-inch and six 6-inch guns. They were built in 1898, and reconstructed in 1907.

The finest protected cruisers of the German navy are the five scout cruisers of the "Karlsruhe," the "Breslau," the "Kolberg," the "Dresden," and the "Stettin" classes. Much has been heard of these ships during the present war. They are so fast, many of them having speeds of from 26 to 28 knots, that the fast protected and armored cruisers of the British and French are unable to capture them; and they can overtake the speediest of the merchant ships afloat.

At the opening of the war Germany had 130 destroyers in commission, and no doubt she is rushing work with feverish haste upon those which are now building. Her destroyers, especially those built since 1905, are fine vessels of their type, varying from 525 to 820 tons in displacement, and having speeds of from 30 to 32.5 knots. They are excellent sea boats, and Germany has paid particular attention to this arm of her torpedo service. It is probable that before the war is ended these craft will have crippled or sunk many a first-class ship connected with the navies of the enemy.

The Germans were slow to take up the submarine; but as soon as this type of craft had proved its great offensive and defensive value, the navy paid great attention to its development. At the opening of the war 21 submarines were in commission. Their submerged displacement varies from 250 to 800 tons.

When buying incandescent lamps consider



An actual photograph showing how much more light is given by a 100-watt Mazda than by 100-watt Carbon lamp. Both are used with the same reflectors.
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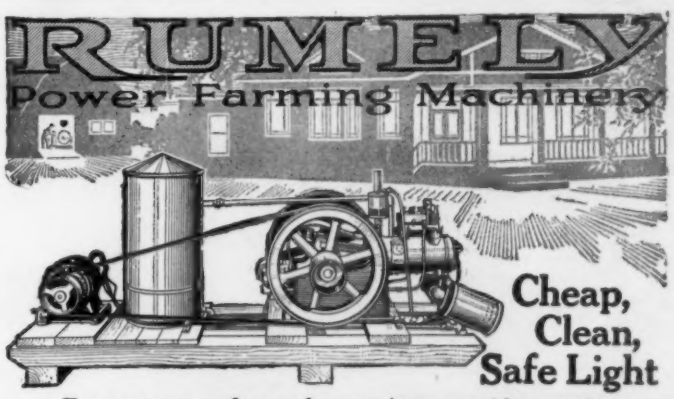

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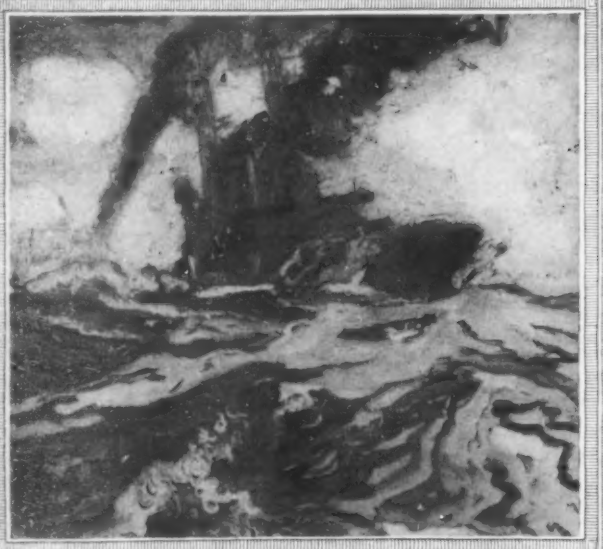

Painting by Henry Reuterdahl

Being a reprint of articles in the *Scientific American* by Secretary of the Navy, Josephus Daniels, Assistant Secretary of the Navy, Franklin D. Roosevelt, and J. Bernard Walker, Editor of the *Scientific American*.

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Rifle Fire and Aircraft

THE experiment of shooting with a rifle at an army target from an aeroplane has been tried by Edward C. Crossman, who tells his story in the *United Service Magazine*. The targets used were six feet square, with a 20-inch bull's eye, and constitute the mark used at 500 and 600 yards in army slow fire practice, so the task set for the aerial marksman was decidedly severe, especially as his work had to be done under particularly trying conditions.

"In front of me stretched the hood, covering, like the hood of a motorcar, the engine of the tractor biplane," says Mr. Crossman. "My left elbow rested comfortably on the top of the hood, the muzzle of the light sporting Springfield protruded beyond a pair of crossed stays running from upper to lower plane.

"Just under my left elbow, as I sat half faced to the right, were the four black pipes of the exhaust, innocent of muffler and but a few feet from my ears.

"The muzzle of the rifle did not clear the forward part of the hood, and I was implored by Earl Dougherty, the aviator, and by Gage, the owner of the great tractor, not to shoot off either the crossed stays or the top of the radiator just below my rifle. They made me nervous, there were too many things to consider. Just above the breech of the rifle ran the flexible tube of the gas line from the tank just over my head. I was beseeched not to let the rifle recoil into this tube and break it, lest the engine stop and we be forced to do some unplanned volplaning with the alighting not of the best."

With the engine chattering under his elbow like a rapid fire gun the machine swept around the field, and the targets were discovered as a far off postage stamp affair against brown ploughed earth, but too distant for the experiment, so the craft was turned, and, pitching and vibrating unsteadily in the "rough air," a long circuit was made to get within range; and it became evident that it would be a case of snap shooting, and some luck to make a hit under the conditions.

"Heeling over before the heavy breeze under our planes," Mr. Crossman continues, "we turned once more, and this time pointed our bows for the tiny white square a half-mile away. We dropped a little, but it was rougher as we went down. Apparently we were not traveling fast, but the target came to meet us with most amazing rapidity.

"At 400 yards, with the muzzle of the rifle traveling in quick vibrations far larger than the target, I caught the flitting gold bead on the paper, and squeezed the trigger.

"I had expected a surprise party of some sort, but not that sort. The light rifle, fired with the heavy army cartridge, tapped me lightly on the shoulder, but there was not a whisper to announce that the shot had gone, not the faintest sound of the usual Springfield bellow. The roar of the engine and the blades close to me were terrific, but that they could utterly drown the sound of the rifle seemed impossible.

"Seemingly behind the paper there spouted from the soft dry earth a brown column of dust that put an end to any doubt as to whether the rifle had been fired.

"Another shot kicked up a second plume at the range of 200 yards, then we swooped down for the target like a hawk on its quarry. The familiar white paper with its lines and its jet black center came up to meet me at horrifying speed. One more shot tapped my shoulder, and spouted dust behind the paper; then we swept off into the air once more and sought our old height.

"Apparently the last two shots had hit, the dust seemed to be directly behind it, although I could plainly see it from where I sat. We swept around the field in our mile-long circle, while I noted my assistant making frantic signals with his disks that my shots were going high."

A second circuit produced the same results, while in the third attempt the craft was headed point blank for the target,

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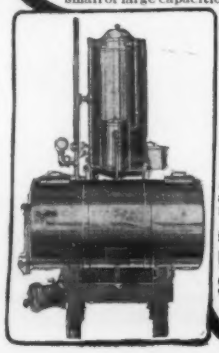

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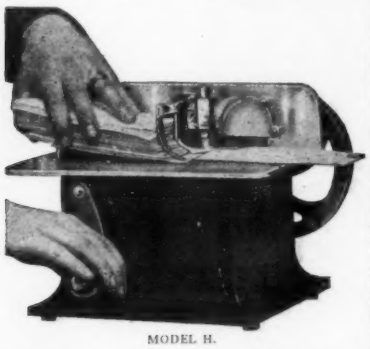

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but the marksman, waiting for the last second, pulled the trigger too late, just as the ship shot suddenly upward, sending the last shot higher than any of its predecessors.

The summing up of the trial is instructive, although disappointing for those enthusiasts who expect such universal application of the flying machine.

"Needless to say, the man on the ground with his own rifle is far more formidable to the man in the ship than the airman can ever hope to be to the humble plodder below him. Hitting the ship at a range when fire from the ship becomes remotely effective is an easy task for any skilled shot; and with two passengers, stays, gasoline tank and engine as the vital points of the 'bird,' the pilot will do well not to cross rifles with anybody on the solid ground.

"With a mark 25 feet square, and with circumstances such that the said mark contained no riflemen to reply, the airman might approach the earth and open fire with his own rifle.

"Aside from such combination of fortunate circumstances, the airman will do well to keep out of reach of the humble infantryman below, even though there be but one of the infantrymen, and he be guarding something most desirable to the fliers above him."

The Scientific Side of Baseball

By Arthur Macdonald

MUCH of the matter presented in this article is based upon opinions of the best players in the history of the game, and it is usually the opinion of the player best qualified by his skill and success in the play in question. This is the most that can be done in any scientific study, where a sufficient number of facts have not been recorded. If, as I shall suggest later, everything that takes place in the game were recorded, it would not be necessary to depend so much upon opinion. A rigid scientific study of baseball is, therefore, not as yet possible.

Fielding.—The great thing in fielding is to know where to throw the ball after you have caught it, and to be careful how you throw, for more games are lost by wild throws than any other kind of error. If not possible to keep a man from running to home base, you can throw it as if you meant to send it home, but really for the pitcher to put men out on bases.

Fumbling the Ball.—If you fumble a ball so that it is too late to throw to first base, nevertheless make a motion as if you intended to do it, but throw to another base, to retire some runner who thought you were going to throw to first. On the other hand, a little fumbling may be purposely done, to coax the runner to make the next base and be thrown out.

To Put Out Men Overrunning Bases.—When a runner is on first and an infielder throws the batter out, throw the ball to second, as the man running from first often overruns the base. For the same reason, if a man is on first and a ball is batted to left field for a hit, let the fielder shoot the ball to second, while pretending he is going to throw to third, and he will often put the man out on second.

Difficulties of Right Fielder.—The right fielder has special difficulties, because balls hit in that direction curve sharply in the air and compel him to extend his territory far over the line. These curves from right-hand batters are especially troublesome. The left fielder has the same difficulty, but in a less degree. The right fielder is called "Old Probabilities." It is the opinion of many that right field should be played in close, except in the case of certain batters whose habits are known. A few fielders claim that they can tell by the sound of the bat into which field the ball is coming. I have found by listening very carefully that this difference in sound is a fact.

When a right-handed pitcher delivers a low curved ball to a left-handed batter, the probabilities are the ball will be hit to right field. If the first and second basemen and right fielder know this they have a special tip. If a high ball is to be delivered to a left-handed batter, the first and second basemen upon getting the sig-

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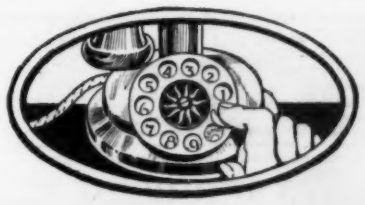

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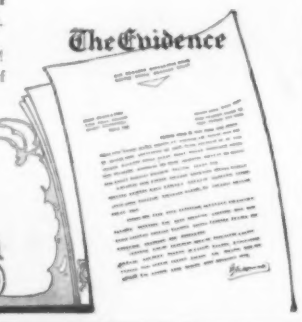

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nal should move up toward second. Also a low curve for a right-hand batter will probably go to left field. A fast, straight ball is liable to be hit to right field.

Other Points in Fielding.—If three men are on bases with one out, do not play in so close. If the ball be hit to shortstop or third baseman quickly, do not throw home, but to second to make a double play and end the inning.

When an outcurve is to be pitched the third baseman and shortstop should move toward second base.

To entrap a grounder, get in front of the ball and keep the hands as near the body and feet as possible, and if you fumble you generally stop the ball at least. If you reach forward to meet the ball it is apt to hit your arms and bound away.

It might be noted in passing that sometimes an outfielder misses a ball, because he does not keep his eye constantly on the batter. He has more excuse for this than the infielder because, especially in a "pitcher's game," it requires much patience to keep up a constant watch on the batter when very few, and sometimes no balls come to the fielder. This condition might be improved by better batting, and if the fielding is also good, the game will be thrilling for the spectators.

Some of the best fielders do not necessarily have the highest averages, for they will attempt to reach flies that the ordinary fielder never could or seldom would try to get. The reason averages do not tell the whole truth is that the official score does not record these omissions of the mediocre player.

Pitchers.—Modern pitchers are not ball players in the ordinary sense. For state the numerous qualifications of a ball player, and the pitcher will fulfill few of them. The pitcher, for instance, is rarely a good batter or base runner.

Pitching has been so highly developed as to become the most specialized feature of the game. The pitcher must study each batter and deliver him the kind of ball he does not like. The majority of games are won or lost by pitchers blundering at the crucial moment.

One pitcher had a legal balk motion. He acquired this by pitching at a mark on a fence for first base while looking at another mark which stood for the home plate. By faithful practice he could suddenly throw to first base and put runners out while looking straight at the batter.

Pitchers sometimes complain of their support, but they would receive better support if they would take the trouble always to signal, or have others signal the basemen and fielders as to what kind of ball they purpose to deliver next.

Sometimes a pitcher, who is called a "waster," never puts a ball over the plate until compelled to do so, but throws it high, low inside or outside to make the batter hit bad balls.

In defense, pitching is rated as high as 80 and as low as 20 per cent of the game.

A Spit-Ball Pitcher.—A star spit-ball pitcher follows two of his spit-balls (which drop sharply when crossing the plate) by a straight fast one which invariably jumps when it reaches the batter. This jump, which is about three or four inches, looks much greater to the batter, who has just seen the spit-ball drop on him, so that expecting another spit-ball, the batter who has just swung over one is very liable to swing as far under the straight ball. A spit-ball is difficult for catchers to manage, especially when men are on bases.

Spit-ball seems to have been dropped by some for esthetical and other reasons.—Abstracted from *American Physical Education Review.*

An Electrical Signal Invented by Fessenden.—Reginald A. Fessenden, of Brant Rock, Mass., has secured a patent, No. 1,101,914, providing an apparatus for signaling by electro-magnetic waves in which a radiating conductor close to the earth, and grounded at both ends, lies in the direction of propagation of the radiated waves. Another patent, No. 1,101,915, to the same inventor provides an addition for dissipating any portion of the electrical charge not utilized in producing radiation, by means of low resistance conductors.

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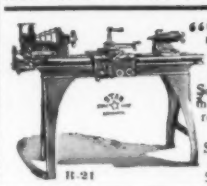

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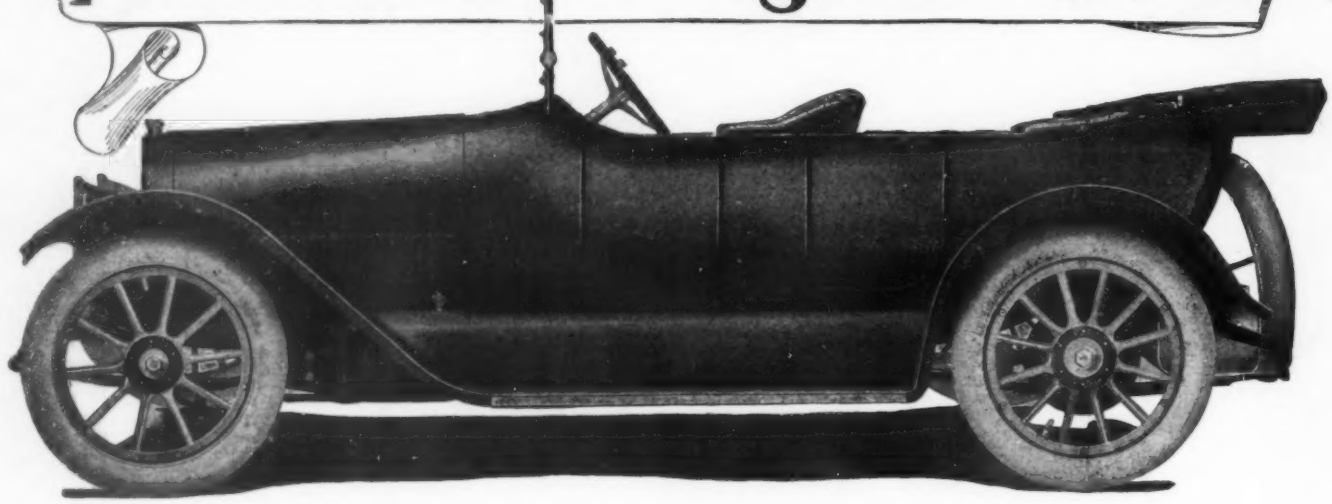

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